NVLAP Lab Code 200087-0

Application For
Grant of Certification

FOR

Model: **Forerunner 910XT**

GPN 011-02622-xx

Low Power Transmitter

FCC ID: IPH-01891

IC: 1792A-01891

FOR

GARMIN INTERNATIONAL, INC.

1200 East 151st Street

Olathe, KS 66062

Test Report Number 110721

Authorized Signatory: Scot D Rogers

Scot D. Rogers

NVLAP Lab Code 200087-0

ROGERS LABS, INC.

4405 West 259th Terrace
Louisburg, KS 66053
Phone / Fax (913) 837-3214

Test Report for Application of Certification

For

GARMIN INTERNATIONAL, INC.

1200 East 151st Street
Olathe, KS 66062

Phone: (913) 397-8200

Mr. Van Ruggles
Director of Quality Assurance

Model: Forerunner 910XT
GPN 011-02622-xx
Low Power Transmitter

Frequency Range: 2,402-2,479 MHz

FCC ID: IPH-01891
IC: 1792A-01891

Test Report Number: 110721

Test Date: October 3, 2011

Authorized Signatory: Scot D Rogers

Scot D. Rogers
Rogers Labs, Inc.
4405 West 259th Terrace
Louisburg, KS 66053
Telephone/Facsimile: (913) 837-3214

Table of Contents

Forward

The following information in this document is submitted for consideration in obtaining Grant of Certification for low power intentional radiator per CFR 47 Paragraph 15.249, and Industry Canada RSS-210, operation in the 2400 – 2483.5 MHz band.

Name of Applicant: Garmin International, Inc.
1200 East 151st Street
Olathe, KS 66062

Model: Forerunner 910XT, GPN 011-02622-xx
FCC ID: IPH-01891 Industry Canada ID: 1792A-01891
Frequency Range: 2402-2479 MHz
Operating Power: Less than 2 mW (measured average power 55.2 dBµV/m @ 3 meters and peak 86.9 dBµV/m @ 3 meters), Occupied band width 1,185.6 kHz, and worst-case receiver radiated emission 20.6 dBµV/m @ 3 meters

Applicable Standards & Test Procedures

In accordance with the Federal Communications Commission and Code of Federal Regulations CFR 47, dated October 1, 2010, Part 2, Subpart J, Paragraphs 2.907, 2.911, 2.913, 2.925, 2.926, 2.1031 through 2.1057, applicable parts of paragraph 15, Part 15C paragraph 15.249, and Industry Canada RSS-210, the following information is submitted. Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in the ANSI C63.4-2009 Document.

Opinion / Interpretation of Results

Test Performed	Minimum Margin (dB)	Results
Antenna requirement per CFR 47 15.203	NA	Complies
Restricted Bands Emissions as per CFR 47 15.205	-17.1	Complies
AC Line Conducted Emissions as per CFR 47 15.207	-11.7	Complies
Radiated Emissions as per CFR 47 15.209	-18.1	Complies
Antenna Power conduction for Receivers per CFR 47 15.111	-33.5	Complies
Emissions per CFR 47 15.249 (Transmitter Average)	-14.8	Complies
Emissions per RSS-210	As Documented	Complies

Statement of Modifications and Deviations

No modifications to the EUT were required for the equipment to demonstrate compliance with CFR 47 Part 15C, or RSS-210 Emissions Requirements. There were no deviations or modification to the specifications.

Environmental Conditions

Ambient Temperature	23.7° C
Relative Humidity	50%
Atmospheric Pressure	1008.9 mb

Units of Measurements

Conducted EMI: Data is in dBµV; dB referenced to one microvolt.

Radiated EMI: Data is in dBµV/m; dB/m referenced to one microvolt per meter.

Radiated Emissions Calculations:

Note: The limit is expressed for a measurement in dBµV/m when the measurement is taken at a distance of 3 meters. Data taken for this report was taken at a distance of 3 meters.

$$dB\mu V/m \text{ @ } 3m = FSM(dB\mu V) + A.F.(dB/m) - Amp\ Gain(dB)$$

Test Site Locations

Conducted EMI	Rogers Labs, Inc. located at 4405 W. 259th Terrace, Louisburg, KS.
Radiated EMI	Performed at Rogers Labs, Inc. 3 meters Open Area Test Site (OATS) located at 4405 W. 259th Terrace, Louisburg, KS.
Site Registration	Refer to Annex for FCC Site Registration Letter, Reference 90910, Industry Canada Site Registration Reference 3041A-1
Accreditation	NVLAP Accreditation Lab Code 200087-0

List of Test Equipment

A Rohde and Schwarz ESU40, Hewlett Packard 8591EM and or 8562A Spectrum Analyzer was used as the measuring equipment for emissions testing. The analyzer settings used are described in the following table. Refer to the annex for a complete list of Test Equipment.

Spectrum Analyzer Settings		
AC Line Conducted Emissions		
RBW	AVG. BW	Detector Function
9 kHz	30 kHz	Peak/Quasi Peak
Radiated Emissions (30 – 1000 MHz)		
RBW	AVG. BW	Detector Function
120 kHz	300 kHz	Peak/Quasi Peak
Spectrum Analyzer Settings		
Radiated Emissions (1 – 40 GHz)		
RBW	AVG. BW	Detector Function
1 MHz	1 MHz	Peak/Average
Antenna Conducted Emissions		
RBW	AVG. BW	Detector Function
120 kHz	300 kHz	Peak

Equipment	Manufacturer	Model	Calibration Date	Due
LISN	Comp. Design	FCC-LISN-2-MOD.CD	10/10	10/11
Antenna	ARA	BCD-235-B	10/10	10/11
Antenna	EMCO	3147	10/10	10/11
Antenna	EMCO	3143	5/11	5/12
Analyzer	HP	8591EM	5/11	5/12
Analyzer	HP	8562A	5/11	5/12
Analyzer	Rohde & Schwarz	ESU40	5/11	5/12

Application for Certification

(1) Manufacturer: Garmin International, Inc.
1200 East 151st Street
Olathe, KS 66062
Telephone: (913) 397-8200

(2) Identification: FCC I.D.: IPH-01891 IC: 1792A-01891

(3) Copy of the installation and operating manual: Refer to exhibit for Draft Instruction Manual.

(4) Description of Circuit Functions, Device Operation: The Forerunner 910XT is a body worn watch incorporating location and navigation functions and low power transmitter. This device features low power transmitter communications operation in frequency band of 2402-2479 MHz.

(5) Block Diagram with Frequencies: Refer to another exhibit for Block Diagram

(6) Report of measurements demonstrating compliance with the pertinent FCC/IC technical requirements provided in this report.

(7) Photographs of equipment are provided in other application exhibits.

(8) Peripheral equipment or accessories for the equipment. Optional equipment available for the EUT includes AC power supply for battery recharge and USB cable for computer interface and connection to AC/DC power adapter. The available configuration options were investigated for this and other reports in compliance with required standards with worst-case data presented.

(9) Transition Provisions of 15.37 are not being requested

(10) The equipment is not a scanning receiver.

(11) The equipment is not a transmitter operating in the 59-64 GHz frequency range.

Equipment Tested Setup, Function and Configurations

Equipment	Model/GPN	Serial Number	FCC ID
Forerunner 910XT (EUT)	011-02622-xx	ENG155	IPH-01891
AC Power Adapter	362-00072-00	N/A	
External Power Pack	010-10644-02	N/A	
USB/Charge Cable	320-00393-00	N/A	
CPU	Studio XPS	921LBN1	

Test Setup

The Forerunner 910XT is a body worn watch with GPS receiver used to receive location and navigation information and incorporates low power transmitter allowing short-range communications in the 2400-2483.5 MHz frequency band. The GPS receiver is used to receive and provide location and information for the user. The transmitter section allows for short-range communications to other compliant equipment. The EUT was arranged as typical user equipment configurations for testing purposes. The transmitter offers no other interface connections than those in the configuration options shown below. The EUT operates from internal batteries only and offers provision for connection to external power source to charge battery as shown below in configuration diagrams. Some configurations shown below are not applicable for this report and have been tested and documented in other relevant documentation. As requested by the manufacturer and required by regulations, the equipment was tested for emissions compliance using the available configurations with the worst-case data presented. Test results in this report relate only to the products described in this report.

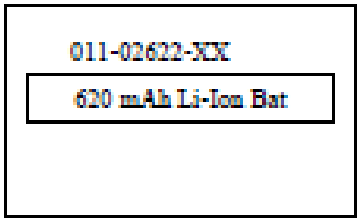
Equipment Function and Testing Procedures

The EUT is GPS location and navigational receiver incorporating a low power transmitter with transmitter operation capability in the 2400-2483.5 MHz frequency band (CFR 47 15.249 and RSS-210). The equipment offers communications to other 2402-2479 MHz compliant devices. Two samples were supplied for testing one production design and the other modified for testing purposes replacing integral antenna with RF connection port for this and other reports and documentation. This modification offered testing facility ability to connect transmitter antenna port to test equipment for antenna port conducted emissions testing.

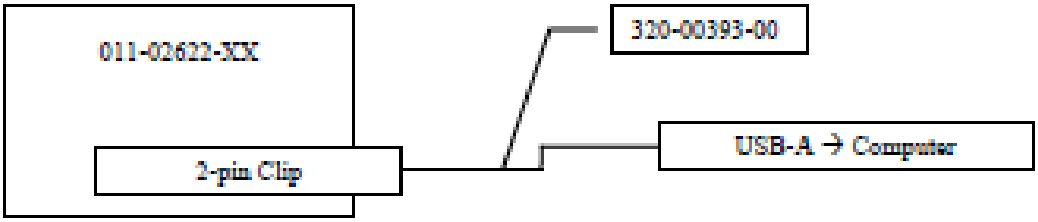
EUT Configuration Options

Configurations for the Forerunner 910XT

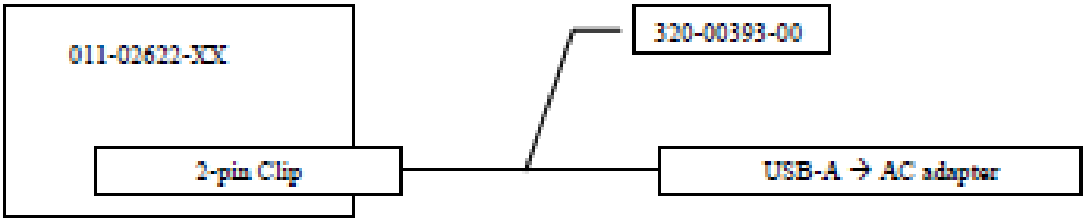
1. 011-02622-XX operating off internal Li-Ion Battery.



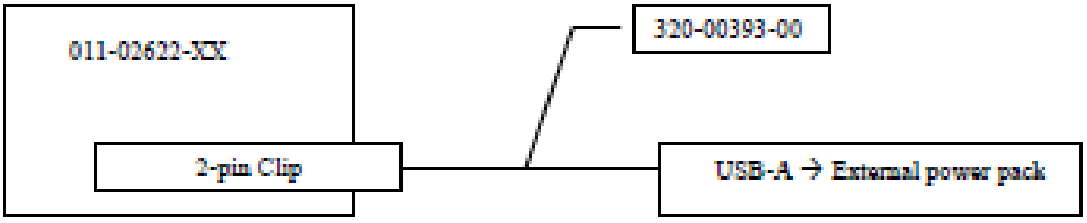
2. 011-02622-XX internal battery charged by PC through 2-pin charge clip (GPN: 320-00393-00).



3. 011-02622-XX internal battery charged by AC adapter (GPN: 362-00072-00) through 2-pin charge clip (GPN: 320-00393-00).



4. 011-02622-XX internal battery charged by external power pack accessory (GPN: 010-10644-02) through 2-pin charge clip (GPN:320-00393-00).



5. 011-02622-XX transmitting data through wireless ANT communication (see ANT test procedure document) and powered by internal batteries.

Subpart C - Intentional Radiators

As per CFR 47 Part 15, Subpart C and RSS-210 the following information is submitted for consideration in obtaining grant of certification for unlicensed intentional radiators.

AC Line Conducted Emission Test Procedure

Testing for the AC line-conducted emissions was performed as defined in sections 7.2.4 and 13 of ANSI C63.4-2009. The test setup, including the EUT, was arranged in the test configurations as shown above during testing. The test configuration was placed on a 1 x 1.5-meter wooden bench, 0.8 meters high located in a screen room. The power lines of the system were isolated from the power source using a standard LISN with a 50-µHy choke. EMI was coupled to the spectrum analyzer through a 0.1 µF capacitor internal to the LISN. The LISN was positioned on the floor beneath the wooden bench supporting the EUT. The power lines and cables were draped over the back edge of the table. Refer to photographs in exhibits for EUT placement used during testing.

Radiated Emission Test Procedure

Testing for the radiated emissions was performed as defined in sections 8.3 and 13.1 of ANSI C63.4-2009. The EUT was arranged in the test configurations as shown above during testing. The test configuration was placed on a rotating 1 x 1.5-meter wooden platform 0.8 meters above the ground plane at a distance of 3 meters from the FSM antenna. EMI energy was maximized by equipment placement, raising and lowering the FSM antenna, changing the antenna polarization, and by rotating the turntable. Each emission was maximized before final data was

taken using a spectrum analyzer. Refer to photographs in exhibits for EUT placement used during testing.

Antenna Requirements

The unit is produced with permanently attached transmitter antenna located inside the sealed case. No provisions for modification or alterations of the antenna configuration are available to the end user. The unique antenna connection requirements of 15.203 are met there are no deviations or exceptions to the specification.

Restricted Bands of Operation

Spurious emissions falling in the restricted frequency bands of operation were measured at the OATS. The EUT utilizes frequency, determining circuitry, which generates harmonics falling in the restricted bands. Emissions were investigated at the OATS, using appropriate antennas or pyramidal horns, amplification stages, and a spectrum analyzer. Peak and average amplitudes of frequencies above 1000 MHz were compared to the required limits with worst-case data presented below. Test procedures of ANSI C63.4-2009 paragraphs 13.1 and 8.3.1.2 were used during testing. No other significant emission was observed which fell into the restricted bands of operation. Computed emission values take into account the received radiated field strength, receive antenna correction factor, amplifier gain stage, and test system cable losses.

Radiated Emissions in Restricted Bands Data

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
2390.0	45.7	N/A	32.9	46.5	N/A	32.9	54.0
2483.5	54.1	N/A	33.5	55.6	N/A	33.6	54.0
4804.0	49.6	N/A	36.9	49.9	N/A	36.8	54.0
4914.0	47.0	N/A	34.8	47.5	N/A	34.8	54.0
4958.0	48.8	N/A	36.3	49.0	N/A	36.3	54.0
7206.0	46.1	N/A	33.5	45.6	N/A	33.4	54.0
7371.0	45.4	N/A	32.9	46.0	N/A	32.8	54.0
7437.0	46.6	N/A	33.4	46.1	N/A	33.3	54.0
12010.0	48.5	N/A	36.4	49.1	N/A	36.5	54.0
12285.0	47.8	N/A	35.1	48.0	N/A	35.4	54.0
12395.0	48.6	N/A	35.6	48.2	N/A	35.3	54.0

Other emissions present had amplitudes at least 20 dB below the limit.
Peak and Quasi-Peak amplitude emissions are recorded above for frequency range of 26-1000 MHz. Peak and Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Summary of Results for Radiated Emissions in Restricted Bands

The EUT demonstrated compliance with the radiated emissions requirements of FCC CFR 47 Part 15.205 and RSS-210 restricted bands of operation. The EUT worst-case configuration demonstrated minimum margin of -17.1 dB below the CFR 47 and RSS-210 limits. Other emissions were present with amplitudes at least 20 dB below the required limits.

AC Line Conducted Emissions

AC Line Conducted Emissions Testing Procedure

The EUT was arranged in typical equipment configurations as described above, USB interface to computer powered by AC power adapter for computer and EUT connected to AC Adapter. Testing was performed with the EUT placed on a 1 x 1.5-meter wooden bench 80 cm above the conducting ground plane, floor of a screen room. The bench was positioned 40 cm away from the wall of the screen room. The LISN was positioned on the floor of the screen room 80-cm from the rear of the EUT. Testing for the line-conducted emissions were the procedures of ANSI C63.4-2009 paragraphs 13.1.3 and 7.2.4. The AC adapter for the EUT/CPU was connected to the LISN for line-conducted emissions testing. A second LISN was positioned on the floor of the screen room 80-cm from the rear of the supporting equipment of the EUT. All power cords except the EUT/CPU were then powered from the second LISN. EMI was coupled to the spectrum analyzer through a 0.1 µF capacitor, internal to the LISN. Power line conducted emissions testing was carried out individually for each current carrying conductor of the EUT. The excess length of lead between the system and the LISN receptacle was folded back and forth to form a bundle not exceeding 40 cm in length. The screen room, conducting ground plane, analyzer, and LISN were bonded together to the protective earth ground. Preliminary testing was performed to identify the frequencies of each of the emissions, which had the highest amplitudes. The cables were repositioned to obtain maximum amplitude of measured EMI level. Once the worst-case configuration was identified, plots were made of the EMI from 0.15 MHz to 30 MHz then data was recorded with maximum conducted emissions levels. . Refer to figures one and two showing plots of the worst-case AC Line conducted emissions of the CPU AC (configuration #2) power adapter while connected to and powering the EUT. Refer to figures three and four showing plots of the worst-case AC Line conducted emissions of the AC power adapter (configuration #3) connected to and powering the EUT.

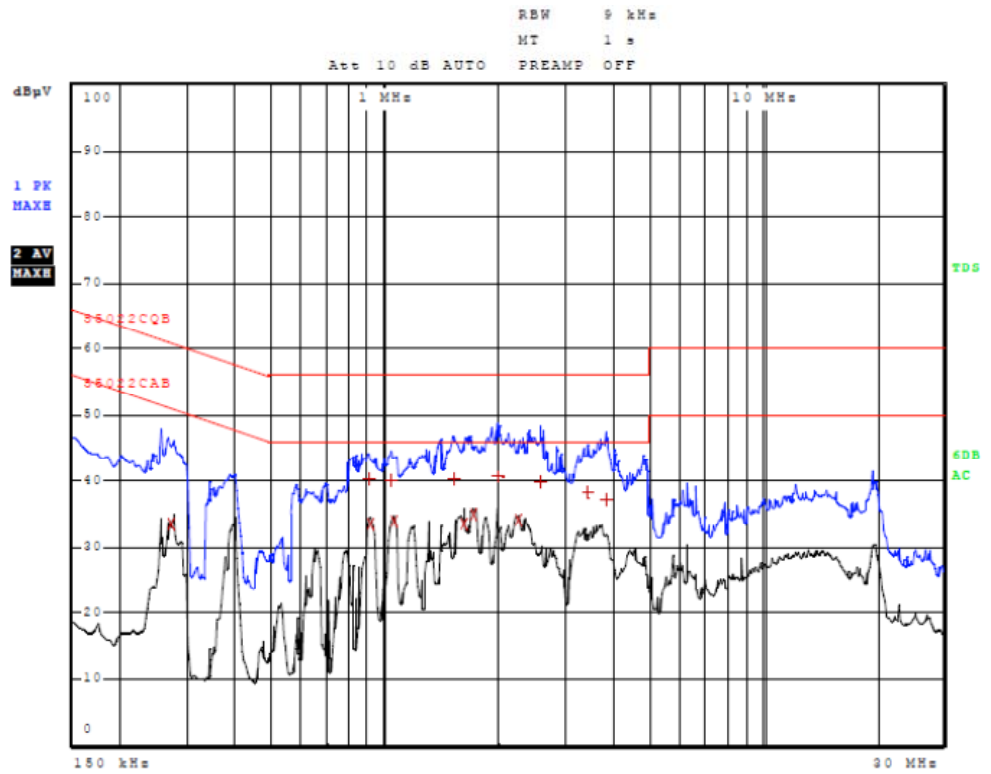


Figure One AC Line Conducted emissions of EUT line 1 (EUT USB CPU AC Adapter)

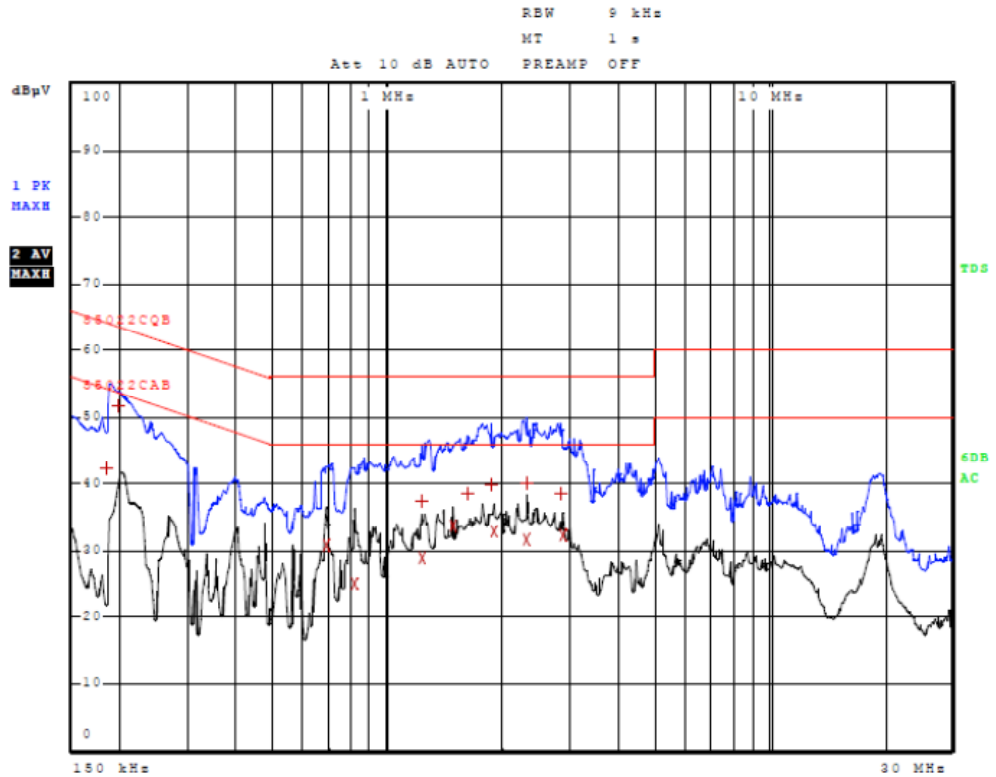


Figure Two AC Line Conducted emissions of EUT line 2 (EUT USB CPU AC Adapter)

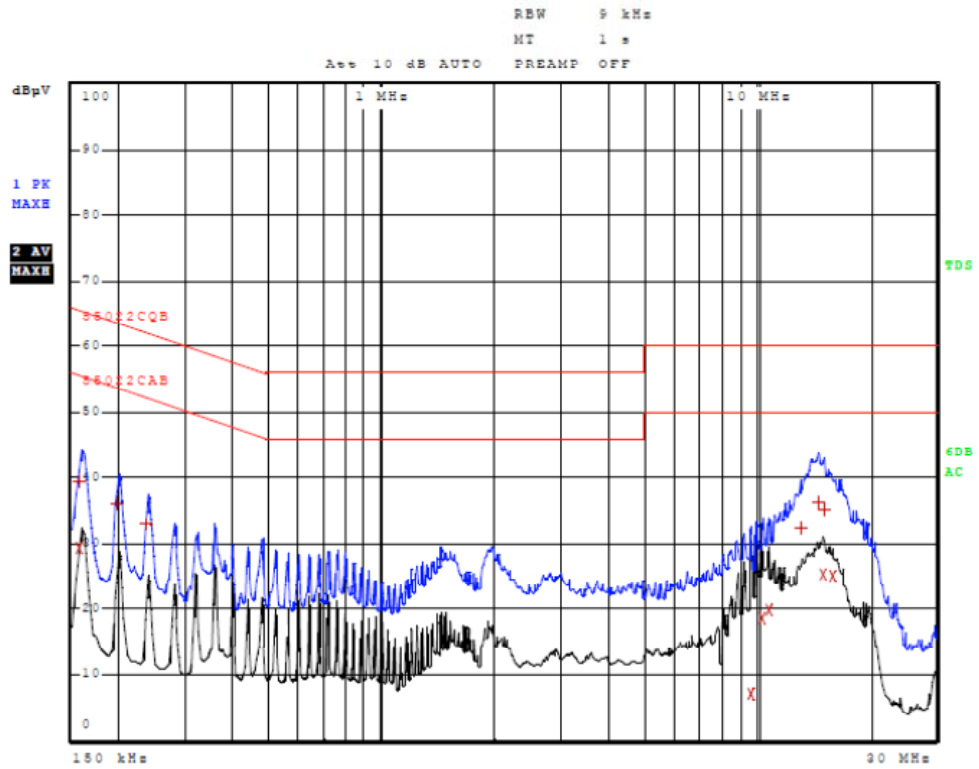


Figure Three AC Line Conducted emissions of EUT line 1 (EUT AC Adapter)

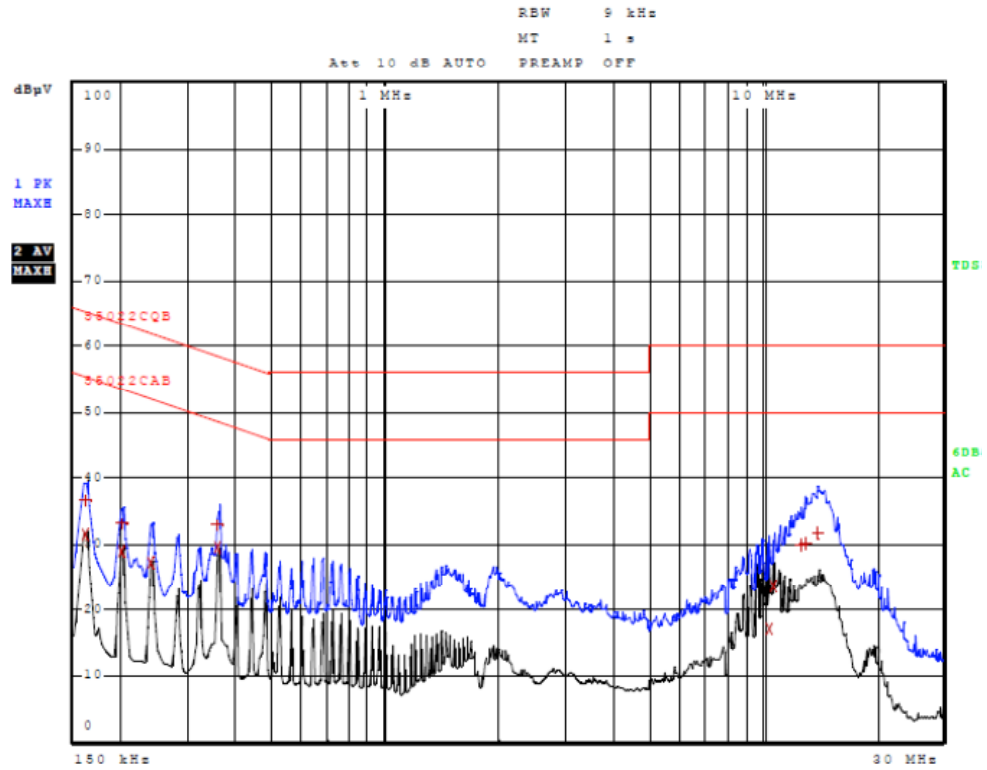


Figure Four AC Line Conducted emissions of EUT line 2 (EUT AC Adapter)

Data AC Line Conducted Emissions (EUT USB CPU AC Adapter)

Line 1 (EUT USB CPU AC Adapter)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
2	274.000000000 kHz	33.55	Average	-17.44
1	902.000000000 kHz	40.26	Quasi Peak	-15.74
2	914.000000000 kHz	33.49	Average	-12.51
1	1.034000000 MHz	40.10	Quasi Peak	-15.90
2	1.050000000 MHz	33.95	Average	-12.05
1	1.514000000 MHz	40.27	Quasi Peak	-15.73
2	1.614000000 MHz	33.59	Average	-12.41
2	1.714000000 MHz	34.94	Average	-11.06
1	1.994000000 MHz	40.70	Quasi Peak	-15.30
2	2.246000000 MHz	34.23	Average	-11.77
1	2.566000000 MHz	39.72	Quasi Peak	-16.28
1	3.450000000 MHz	38.30	Quasi Peak	-17.70
1	3.850000000 MHz	37.36	Quasi Peak	-18.64

Line 2 (EUT USB CPU AC Adapter)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
1	186.000000000 kHz	42.39	Quasi Peak	-21.82
1	198.000000000 kHz	51.49	Quasi Peak	-12.20
2	686.000000000 kHz	30.68	Average	-15.32
2	814.000000000 kHz	25.00	Average	-21.00
1	1.230000000 MHz	37.60	Quasi Peak	-18.40
2	1.230000000 MHz	28.80	Average	-17.20
2	1.482000000 MHz	33.65	Average	-12.35
1	1.618000000 MHz	38.63	Quasi Peak	-17.37
1	1.858000000 MHz	39.71	Quasi Peak	-16.29
2	1.890000000 MHz	32.94	Average	-13.06
1	2.306000000 MHz	39.98	Quasi Peak	-16.02
2	2.310000000 MHz	31.52	Average	-14.48
1	2.830000000 MHz	38.47	Quasi Peak	-17.53
2	2.874000000 MHz	32.14	Average	-13.86

Other emissions present had amplitudes at least 20 dB below the limit.

Data AC Line Conducted Emissions (EUT AC Adapter)

Line 1 (EUT AC Adapter)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
2	158.000000000 kHz	29.31	Average	-26.26
1	158.000000000 kHz	39.30	Quasi Peak	-26.26
1	198.000000000 kHz	36.01	Quasi Peak	-27.69
1	238.000000000 kHz	32.84	Quasi Peak	-29.33
2	9.628000000 MHz	7.01	Average	-42.99
2	10.312000000 MHz	18.59	Average	-31.41
2	10.712000000 MHz	19.77	Average	-30.23
1	13.056000000 MHz	32.19	Quasi Peak	-27.81
1	14.536000000 MHz	36.23	Quasi Peak	-23.77
2	14.956000000 MHz	25.31	Average	-24.69
1	15.064000000 MHz	35.14	Quasi Peak	-24.86
2	15.864000000 MHz	25.02	Average	-24.98

Line 2 (EUT AC Adapter)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
2	162.000000000 kHz	31.42	Average	-23.94
1	162.000000000 kHz	36.65	Quasi Peak	-28.71
2	202.000000000 kHz	28.96	Average	-24.57
1	202.000000000 kHz	33.16	Quasi Peak	-30.36
2	242.000000000 kHz	27.16	Average	-24.87
2	362.000000000 kHz	29.49	Average	-19.20
1	362.000000000 kHz	32.79	Quasi Peak	-25.90
2	10.332000000 MHz	17.07	Average	-32.93
2	10.656000000 MHz	23.68	Average	-26.32
1	12.604000000 MHz	29.89	Quasi Peak	-30.11
1	12.936000000 MHz	30.06	Quasi Peak	-29.94
1	13.960000000 MHz	31.57	Quasi Peak	-28.43

Other emissions present had amplitudes at least 20 dB below the limit.

Summary of Results for AC Line Conducted Emissions

The EUT demonstrated compliance with the conducted emissions requirements of CFR 47 Part 15C and other applicable standards for Intentional Radiators. The EUT worst-case configuration demonstrated minimum margin of -11.7 dB below the FCC/CISPR quasi peak limit. Other missions were present with recorded data representing the worst-case amplitudes.

Radiated emissions limits; general requirements

General Radiated EMI Testing Procedure

The EUT was investigated while arranged in all typical equipment configurations and operated through all applicable modes. Preliminary testing was performed in a screen room with the EUT positioned 1 meter from the FSM. Investigations were performed to identify the frequencies, which produced the highest radiated emissions. Radiated emission investigations were performed from 9 kHz to 25,000 MHz with the EUT positioned in three orthogonal axes per regulations. Plots were produced of the worst-case radiated emission frequency spectrum from 30 MHz to 25,000 MHz during preliminary testing. Refer to figures five through eleven representing the worst-case radiated emission spectrum as displayed on the spectrum analyzer of EUT worst-case configuration taken in screen room. Frequencies of interest were recorded for use during testing on the OATS. Each emission was then maximized at the OATS site before final radiated emissions measurements were performed. Final data was taken with the EUT located at the open field test site at a distance of 3 meters between the EUT and the receiving antenna. Test procedures of ANSI C63.4-2009 paragraphs 13.1 and 8.3.1.2 were used during radiated emissions testing. The frequency spectrum from 9 kHz MHz to 25,000 MHz was searched for radiated emissions of the EUT. Peak and average amplitudes of frequencies above 1000 MHz were compared to the required limits with worst-case data presented below. Measured emission levels were maximized by EUT placement on the table, changing cable location, rotating the turntable through 360 degrees, varying the antenna height between 1 and 4 meters above the ground plane and changing antenna polarization between horizontal and vertical. Antennas used were Broadband Biconical from 30 MHz to 200 MHz, Log Periodic from 200 MHz to 1 GHz, and/or Biconilog from 30 MHz to 1000 MHz, Double-Ridge horn and/or Pyramidal Horns from 1 GHz to 25 GHz, and amplification stages.

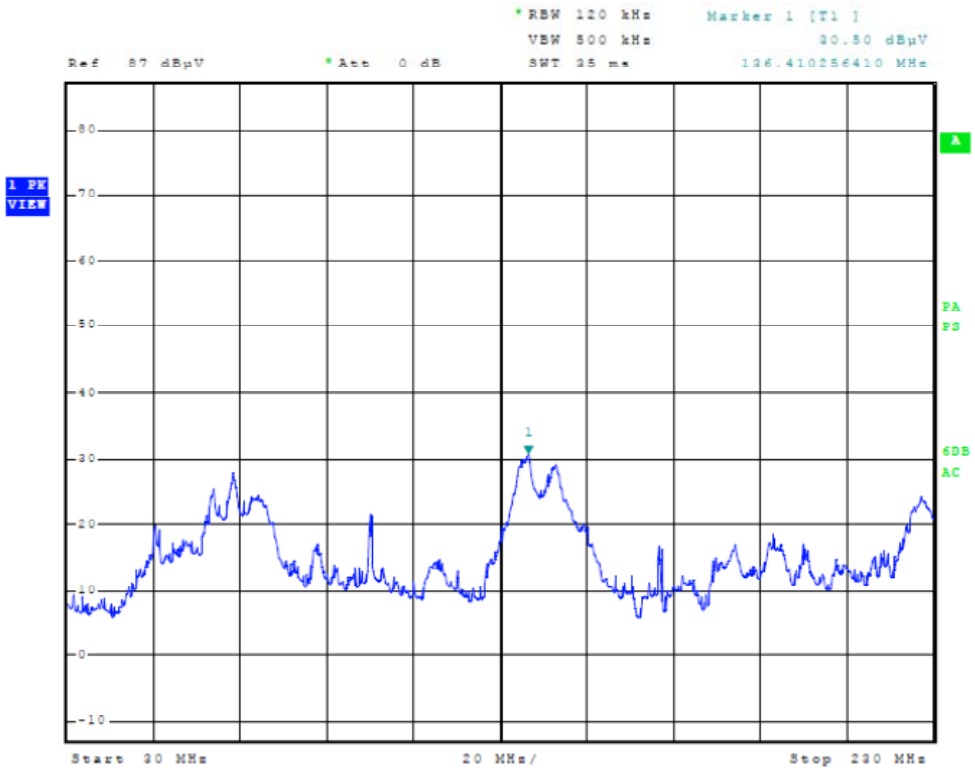


Figure Five General Radiated Emissions in screen room

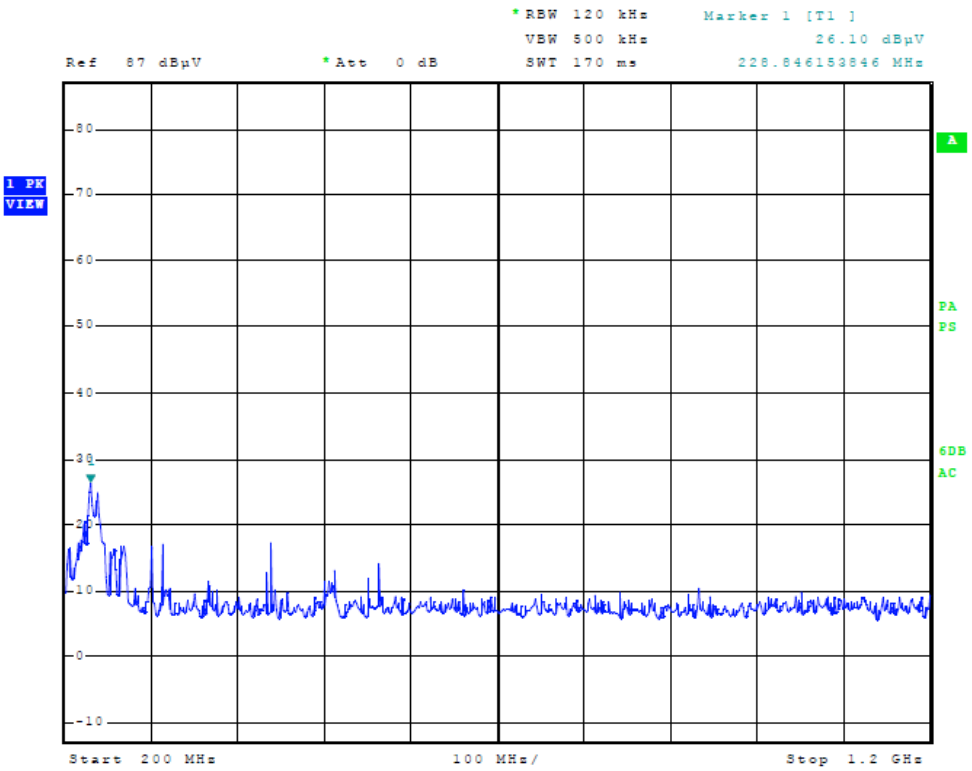


Figure Six General Radiated Emissions in screen room

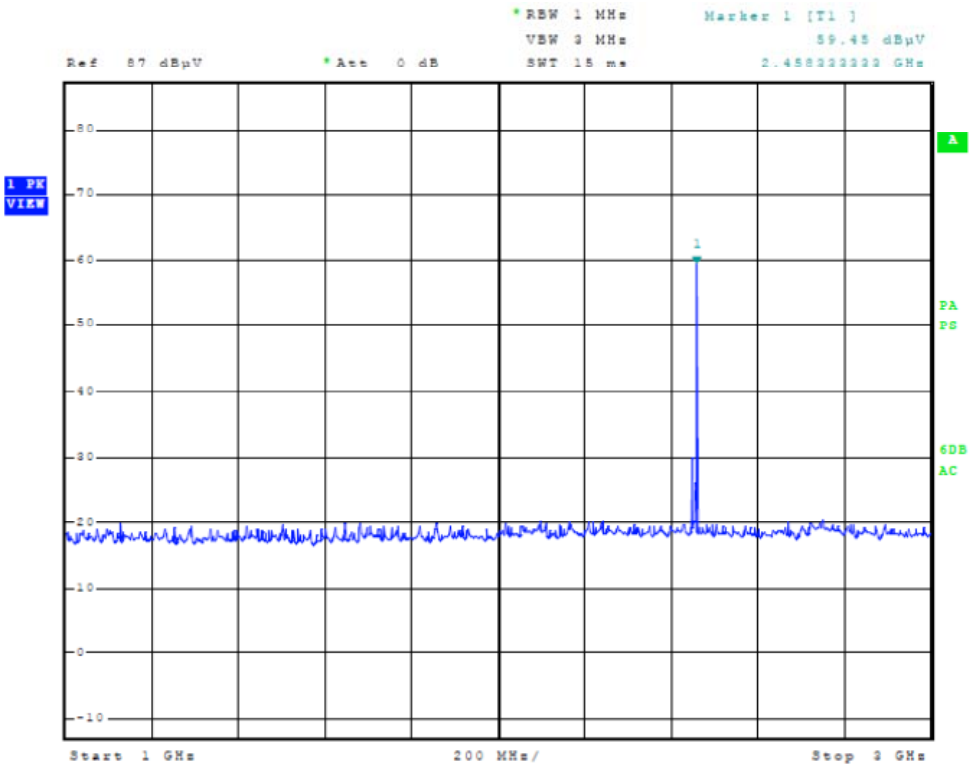


Figure Seven General Radiated Emissions in screen room

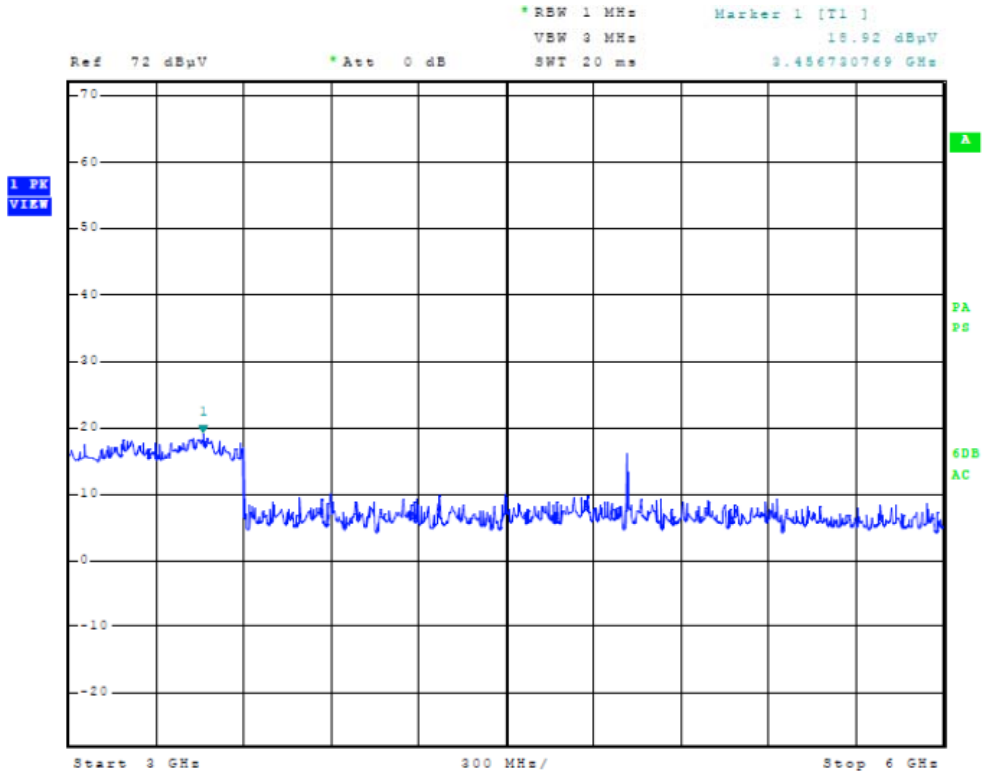


Figure Eight General Radiated Emissions in screen room

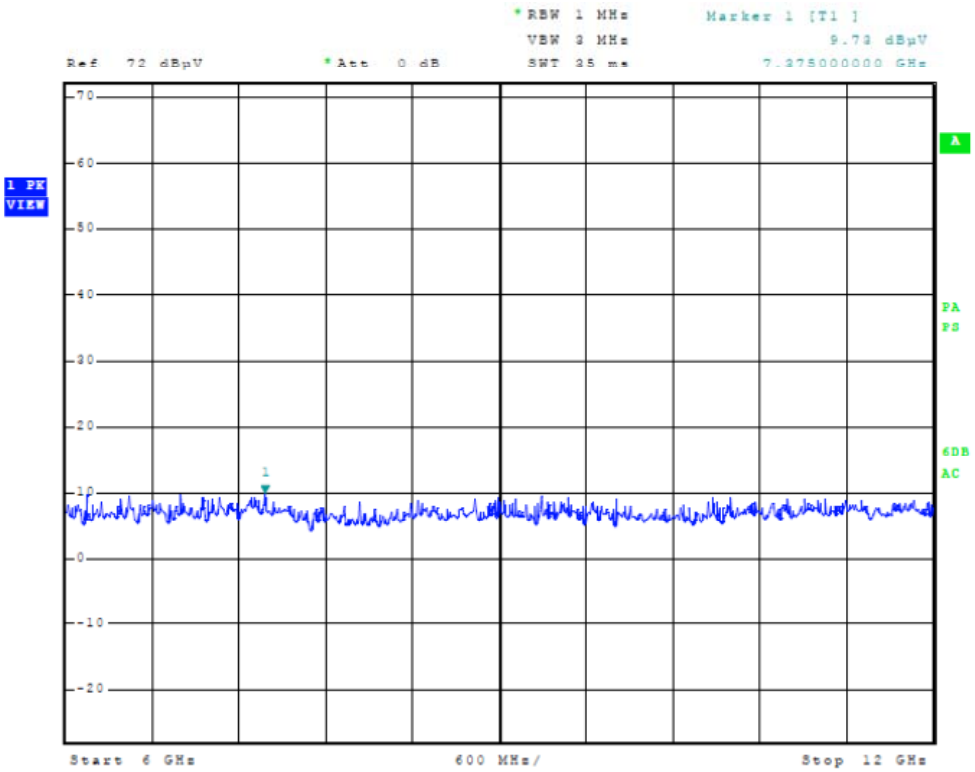


Figure Nine General Radiated Emissions in screen room

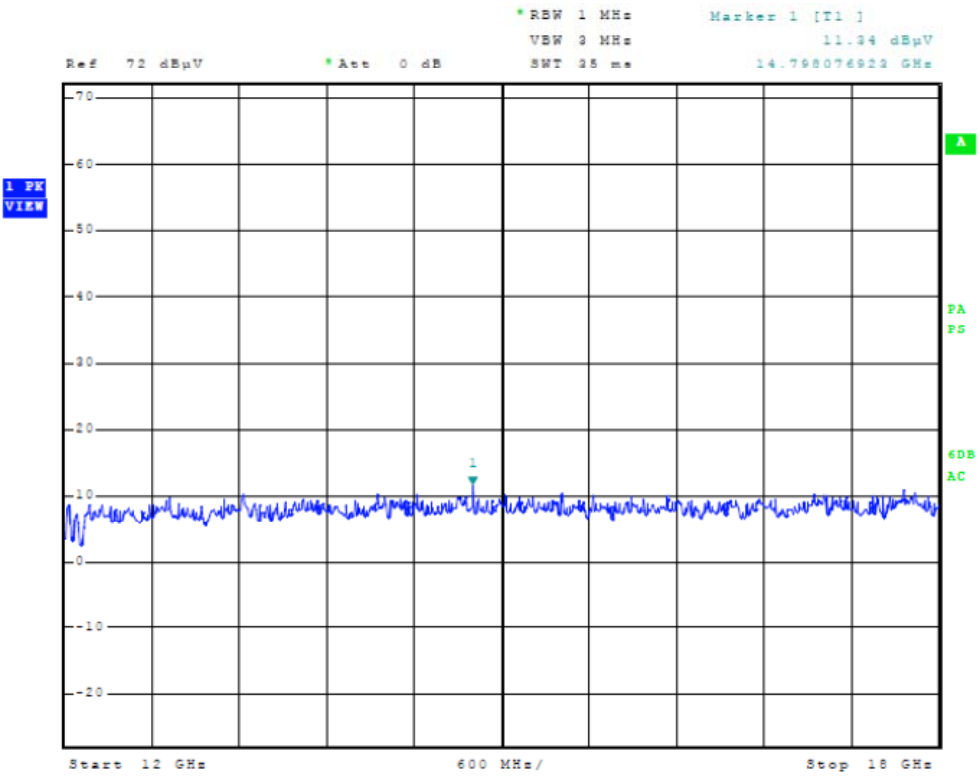


Figure Ten General Radiated Emissions in screen room

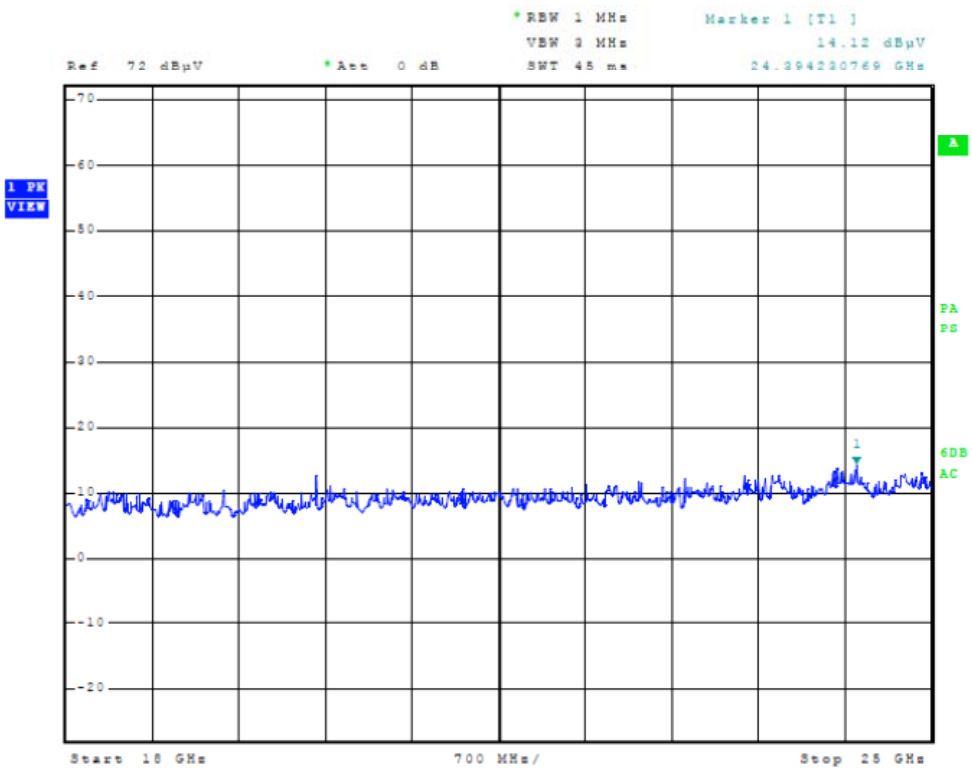


Figure Eleven General Radiated Emissions in screen room

General Radiated Emissions Data (worst-case)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
135.4	38.1	25.0	N/A	29.6	22.3	N/A	43.5
135.7	33.4	24.8	N/A	27.9	22.7	N/A	43.5
142.8	31.8	23.3	N/A	28.7	21.9	N/A	43.5
142.9	32.5	23.5	N/A	29.4	22.4	N/A	43.5
143.2	33.3	25.4	N/A	31.3	24.4	N/A	43.5
143.8	32.2	23.4	N/A	30.2	22.8	N/A	43.5
144.2	33.6	24.5	N/A	31.4	23.4	N/A	43.5
237.2	24.3	18.4	N/A	24.6	18.6	N/A	46.0
266.4	24.9	19.6	N/A	24.4	19.7	N/A	46.0

Other emissions present had amplitudes at least 20 dB below the limit.
Peak and Quasi-Peak amplitude emissions are recorded above for frequency range of 26-1000 MHz. Peak and Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Summary of Results for General Radiated Emissions

The EUT demonstrated compliance with the general radiated emissions requirements of FCC Part 15C, RSS-210 and other applicable standards for Intentional Radiators. The EUT worst-case configuration demonstrated minimum margin of -18.1 dB below the limits. Other emissions were present with amplitudes at least 20 dB below the Limits.

Receiver Antenna Power Conduction Limits

Receivers which provide terminals for the connection of an external receiving antenna may be tested to demonstrate compliance with the provisions of 15.109 with the antenna terminals shielded and terminated with a termination equal to the impedance specified for the antenna, provided these receivers also comply with the following: With the receiver antenna terminal connected to a resistive termination equal to the impedance specified or employed for the antenna, the power at the antenna terminal at any frequency within the range of measurements specified in 15.33 shall not exceed 2.0 nanowatts. The EUT incorporates an integral antenna system for production. A test sample was offered for testing allowing connection to antenna port for testing purposes. The test antenna port was connected to a spectrum analyzer for testing the antenna-conducted emissions. Antenna port conduction testing was performed at temporary antenna test port connected to the spectrum analyzer through a short coaxial cable. The spectrum analyzer provided the 50-ohm load as the antenna. The frequency spectrum was investigated at the antenna port with the worst case data presented. Refer to figures twelve through seventeen showing the spectrum analyzer display of worst-case receiver antenna conduction emissions. Worst-case antenna port conducted emissions data presented. Worst-case (production design sample) receiver radiated emissions were tested at 3 meter OATS. Data presented below demonstrates compliance with regulations.

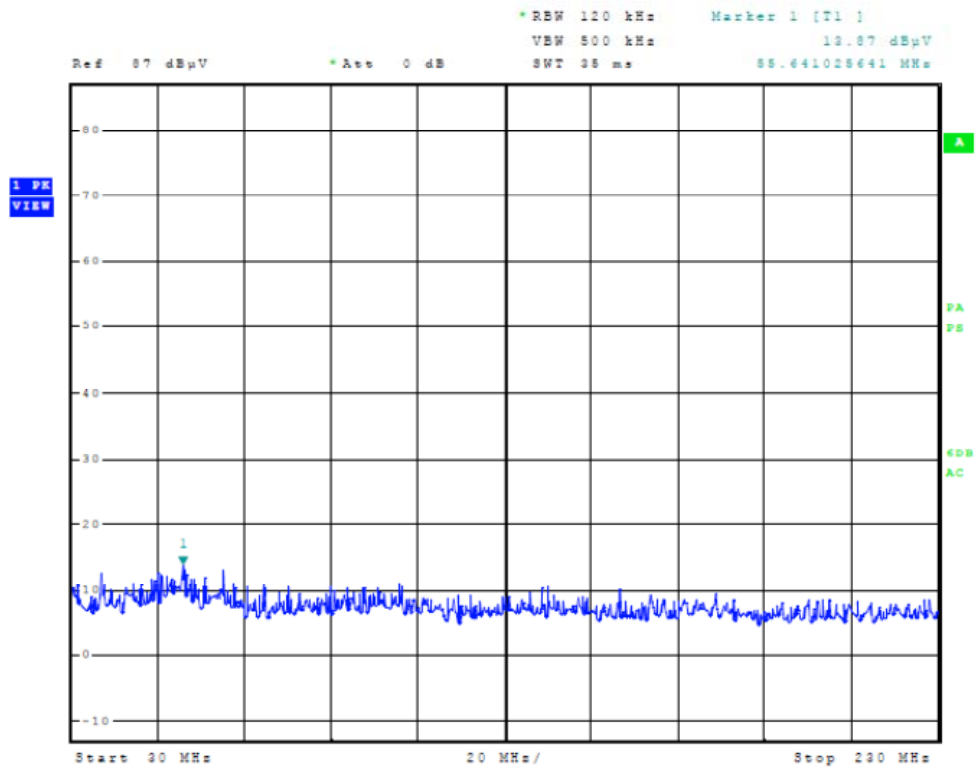


Figure Twelve Receiver Radiated Emissions

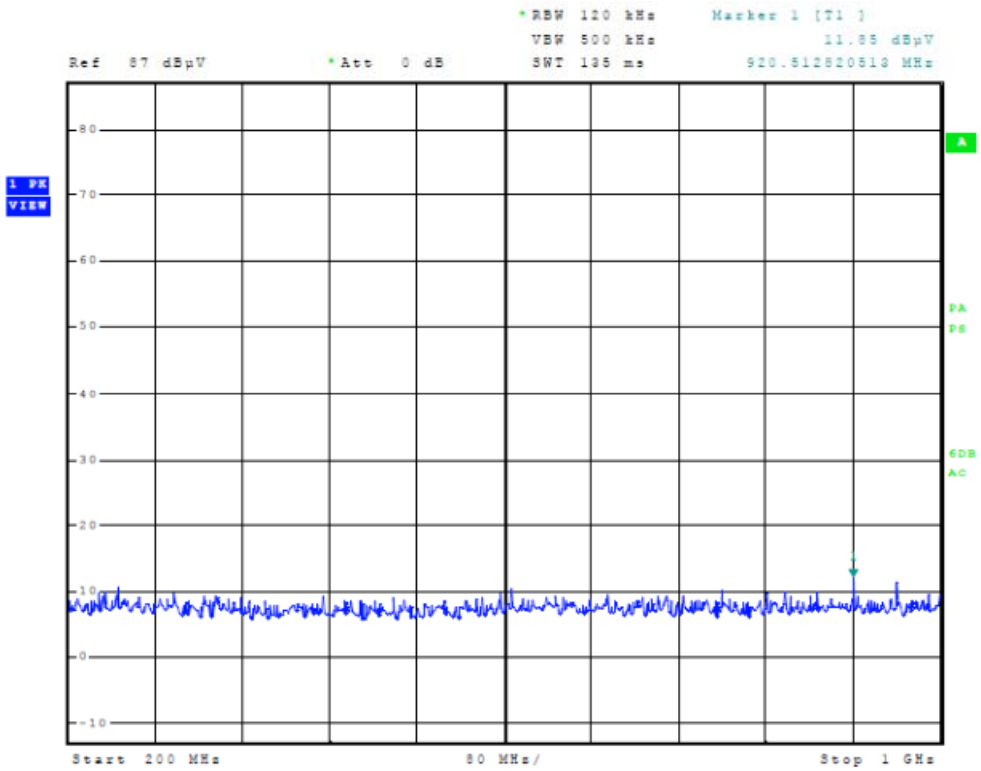


Figure Thirteen Receiver Radiated Emissions

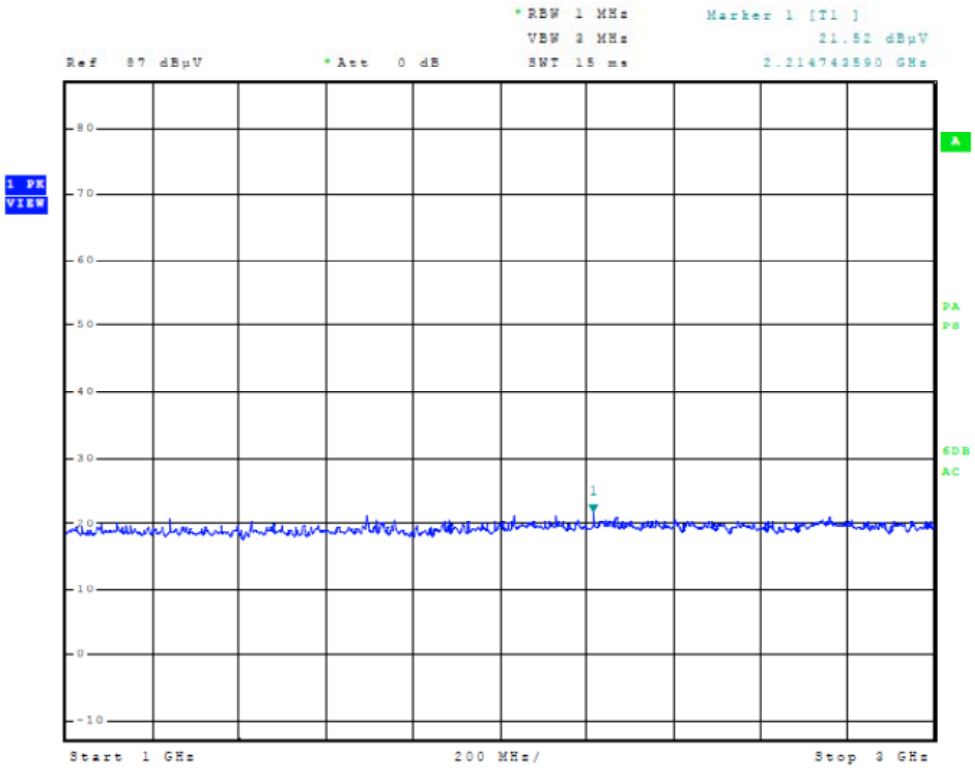


Figure Fourteen Receiver Radiated Emissions

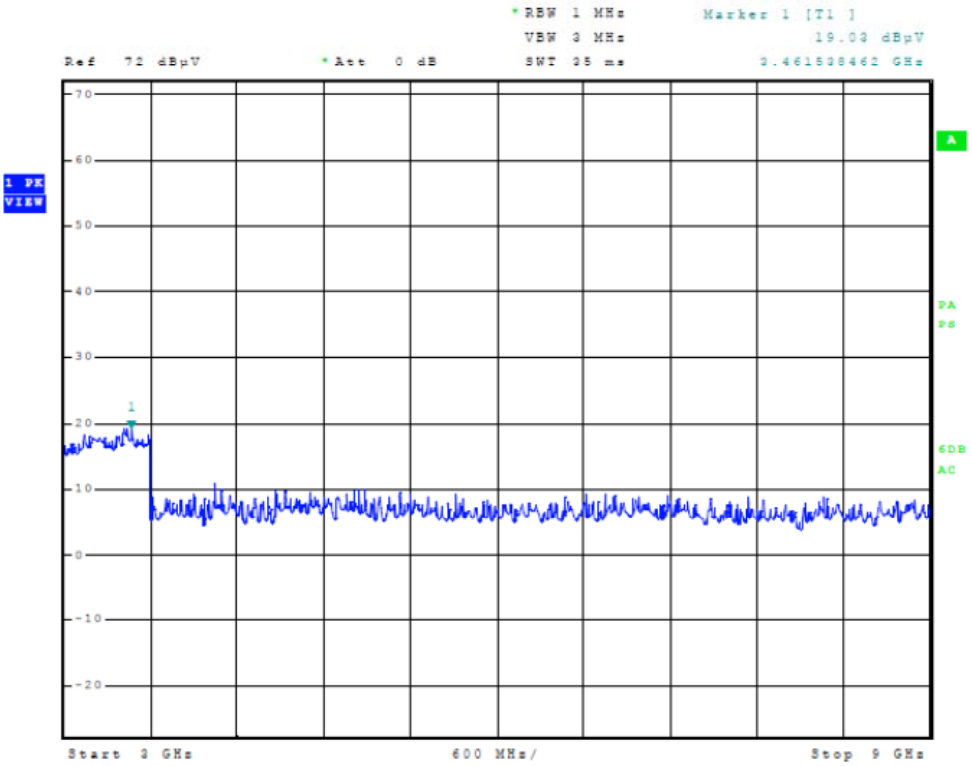


Figure Fifteen Receiver Radiated Emissions

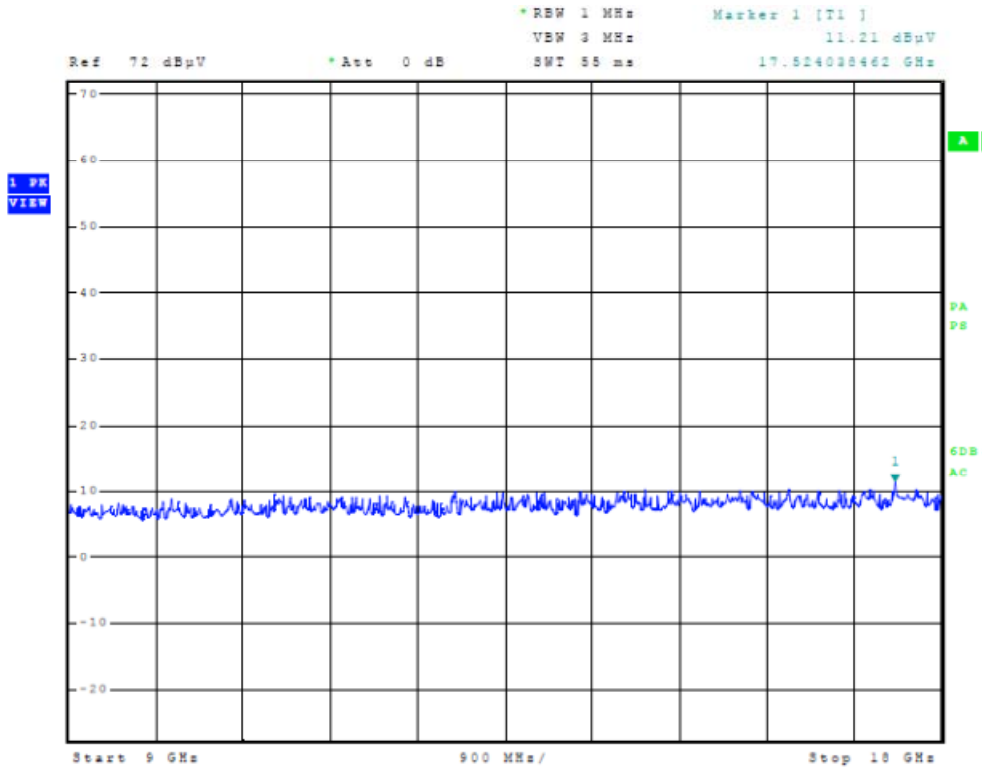


Figure Sixteen Receiver Temporary Antenna Port Conducted Emissions

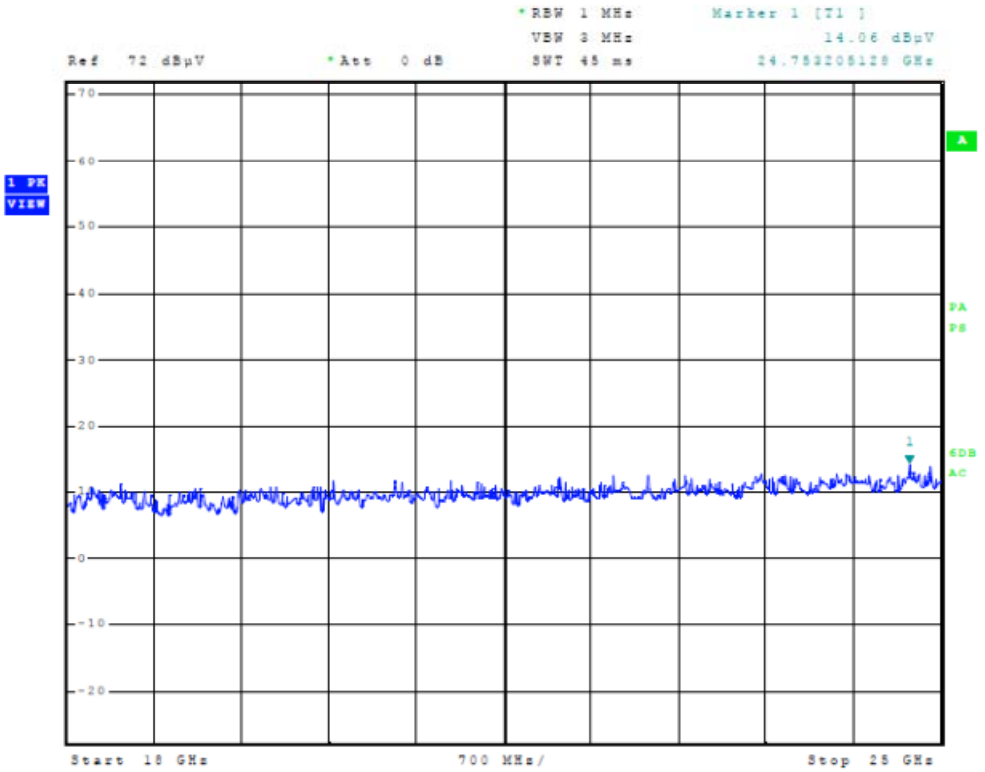


Figure Seventeen Receiver Temporary Antenna Port Conducted Emissions

Receiver Antenna Conducted Emissions Data (Sample 2 temporary antenna port)

Frequency (MHz)	Emission Level (dBm)	Limit (dBm)	Margin (dB)
2457.5	-90.5	-57.0	-33.5

Other emissions present had amplitudes at least 20 dB below the limit.

Receiver Radiated Emissions Data

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
2457.0	25.6	N/A	20.6	25.5	N/A	19.6	54.0

Other emissions present had amplitudes at least 20 dB below the limit.
Peak and Quasi-Peak amplitude emissions are recorded above for frequency range of 26-1000 MHz. Peak and Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Summary of Results for Receiver Emissions

The EUT demonstrated compliance with the antenna conducted emissions requirements of CFR 47 Part 15B and RSS-GEN with an antenna port conducted minimum margin of -33.5 dB below requirements (measured at test ant port). The EUT demonstrated compliance with the radiated emissions requirements of CFR 47 Part 15B and RSS-GEN with a minimum -33.4 dB margin below requirements. Other emissions were present with amplitudes at least 20 dB below the CFR 47 15 and Industry Canada limits.

Operation in the Band 2,400-2,483.5 MHz

The power output was measured on an open area test site @ 3 meters. Test procedures of ANSI C63.4-2009 paragraphs 13.1 and 8.3.1.2 were used during testing. The EUT was placed on a wooden turntable 0.8 meters above the ground plane and at a distance of 3 meters from the FSM antenna. The peak and quasi-peak amplitude of frequencies below 1000 MHz were measured using a spectrum analyzer. The peak and average amplitude of frequencies above 1000 MHZ were measured using a spectrum analyzer. The amplitude of each emission was then recorded from the analyzer display. Emissions radiated outside of the specified bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in 15.209, whichever is the lesser attenuation. Refer to figures eighteen through twenty-nine showing the frequency and amplitude of emission displayed on the spectrum analyzer measured at the temporary test antenna port (performed on sample #2). The amplitude of each radiated spurious emission was measured on the OATS at a distance of 3 meters from the FSM antenna (testing performed on sample representative of production with integral antenna). The amplitude of each radiated spurious emission was maximized by varying the FSM antenna height, polarization, and by rotating the turntable. A Biconilog Antenna was used for measuring emissions from 30 to 1000 MHz, a Log Periodic Antenna for 200 to 1000 MHz, and Double-ridge horn and/or Pyramidal Horn Antennas from 1 GHz to 25 GHz. Emissions were measured in dBµV/m @ 3 meters.

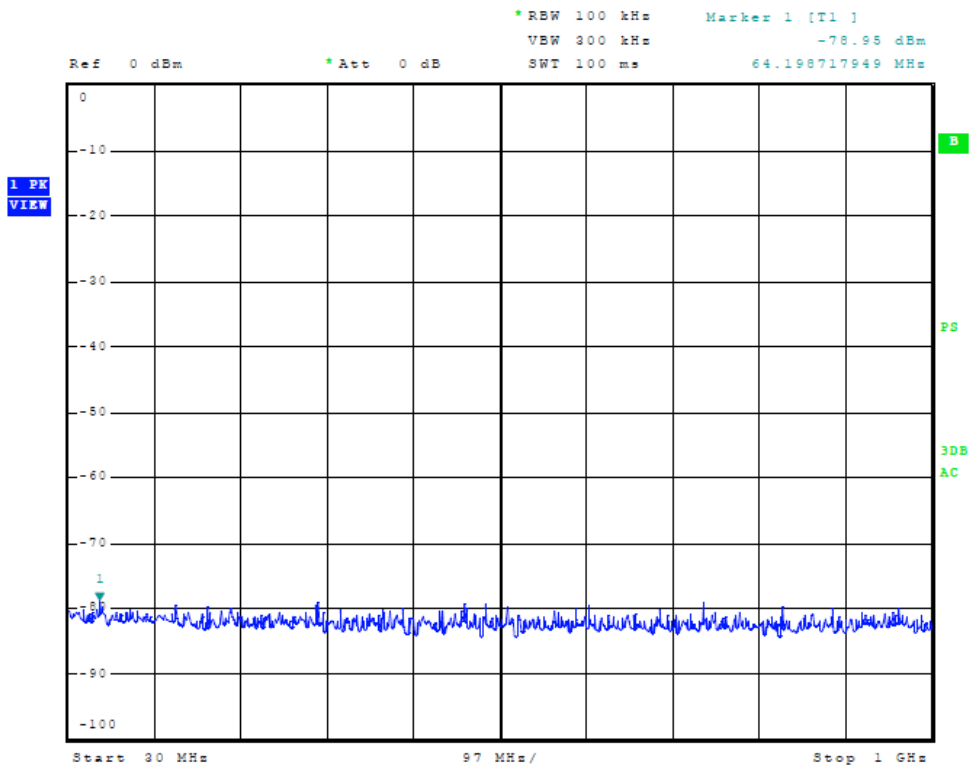


Figure Eighteen output measured at temporary antenna terminal

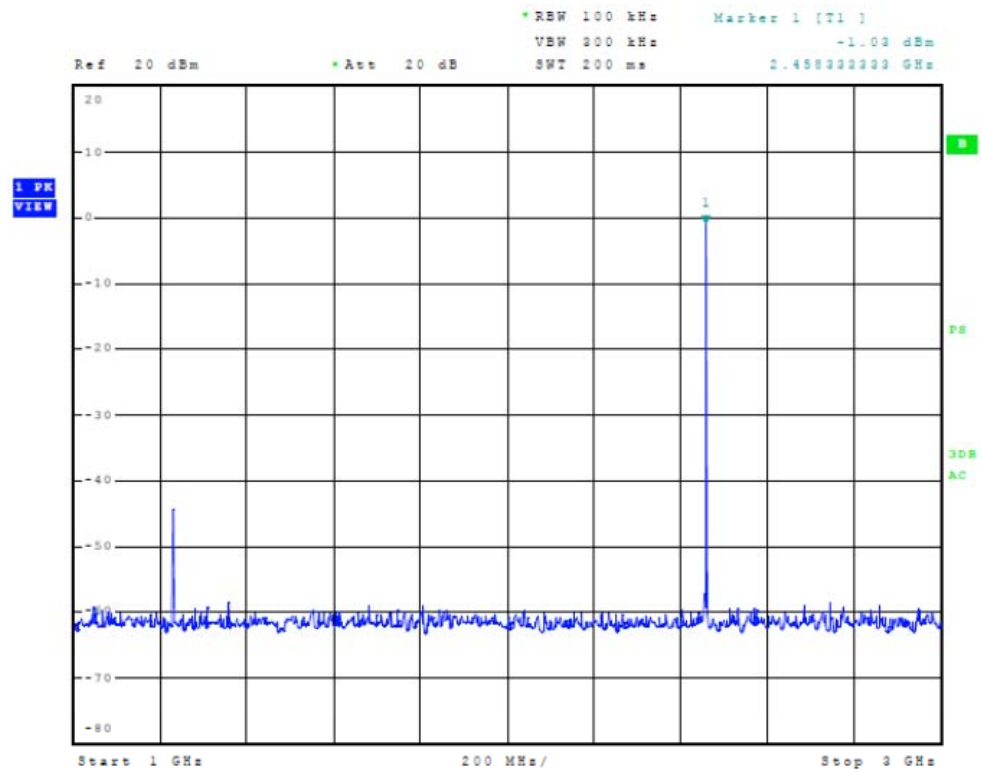


Figure Nineteen output measured at temporary antenna terminal

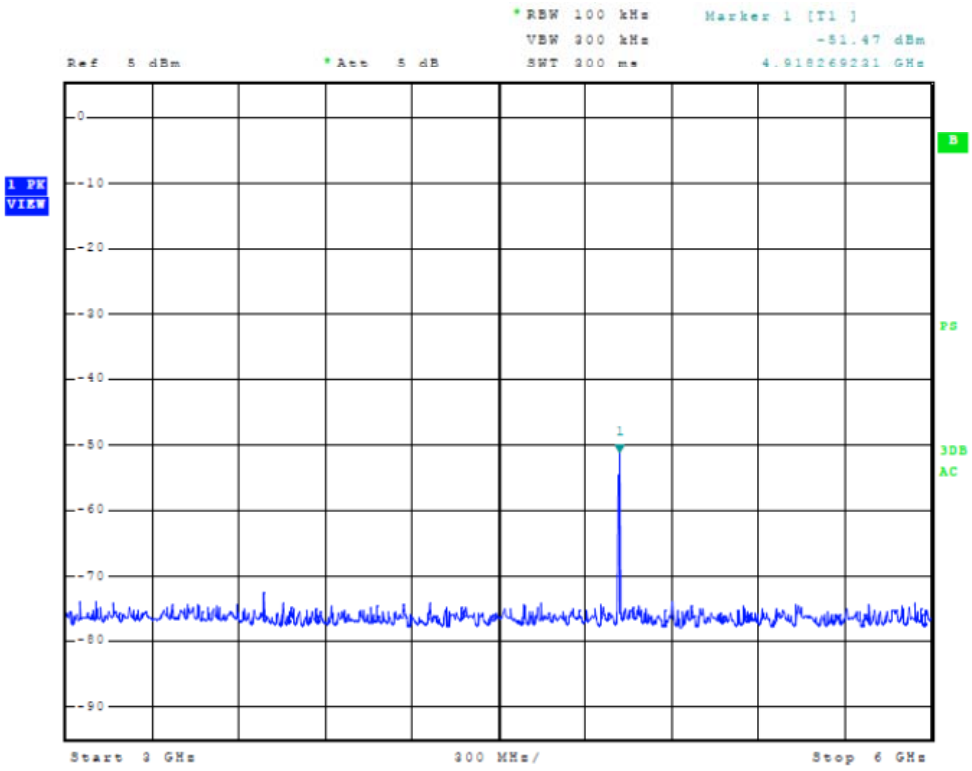


Figure Twenty output measured at temporary antenna terminal

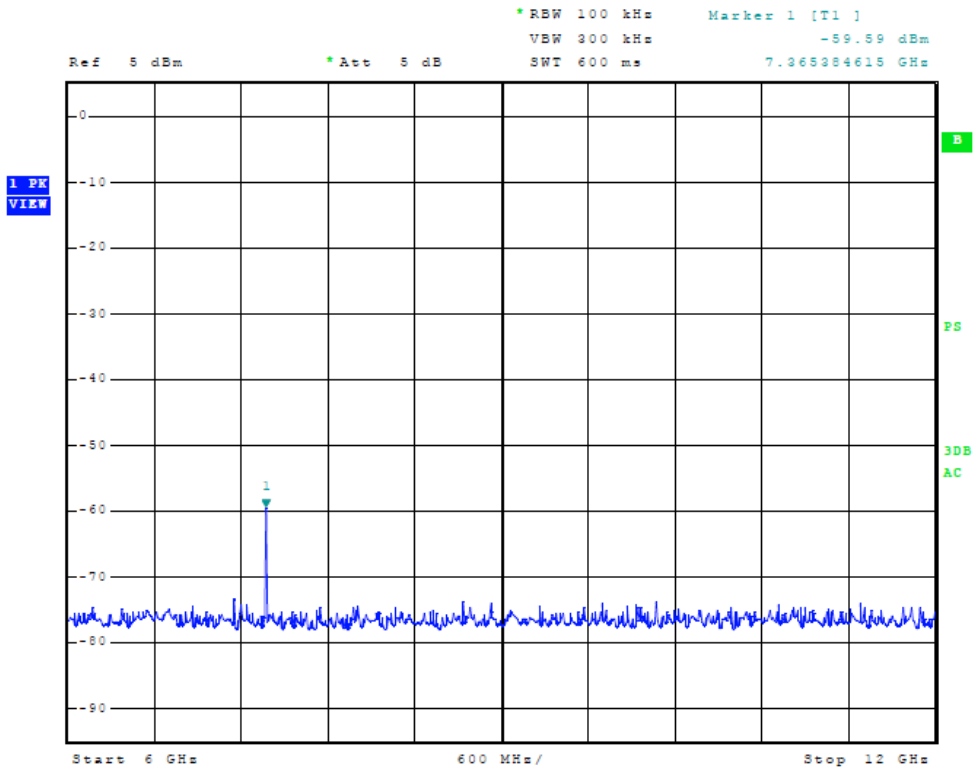


Figure Twenty-one output measured at temporary antenna terminal

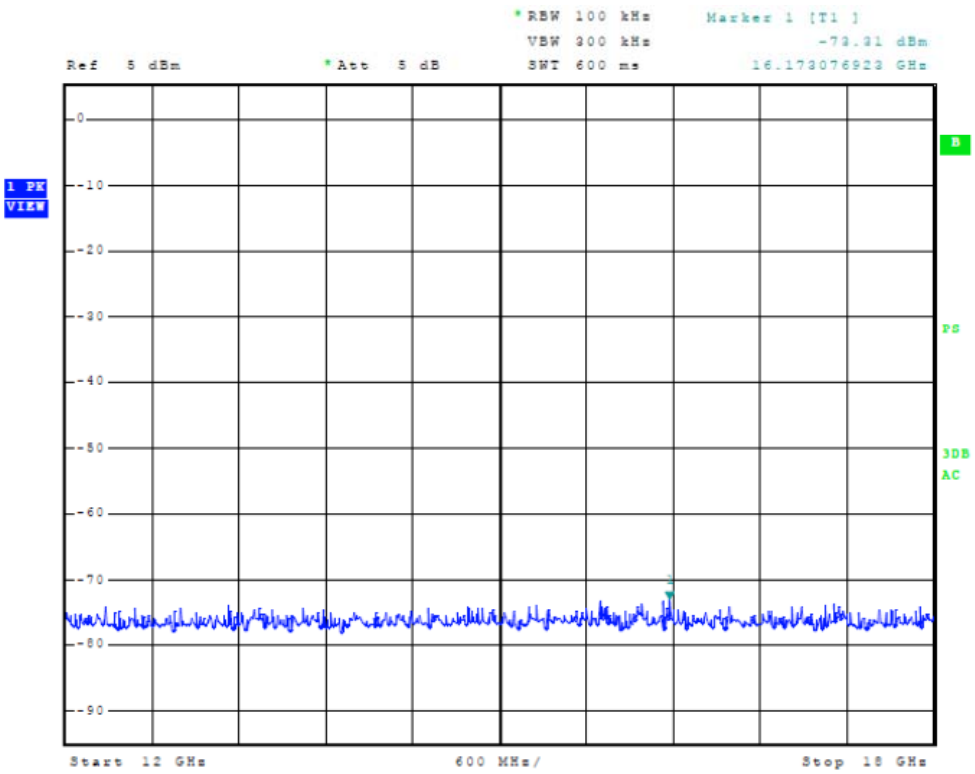


Figure Twenty-two output measured at temporary antenna terminal

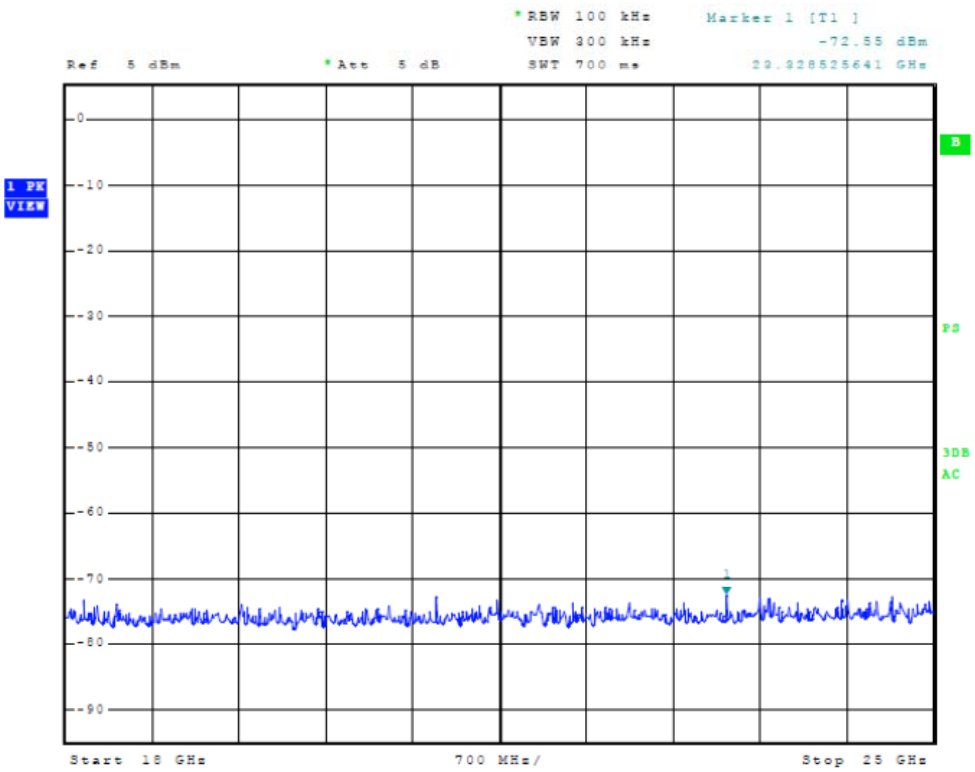


Figure Twenty-three output measured at temporary antenna terminal

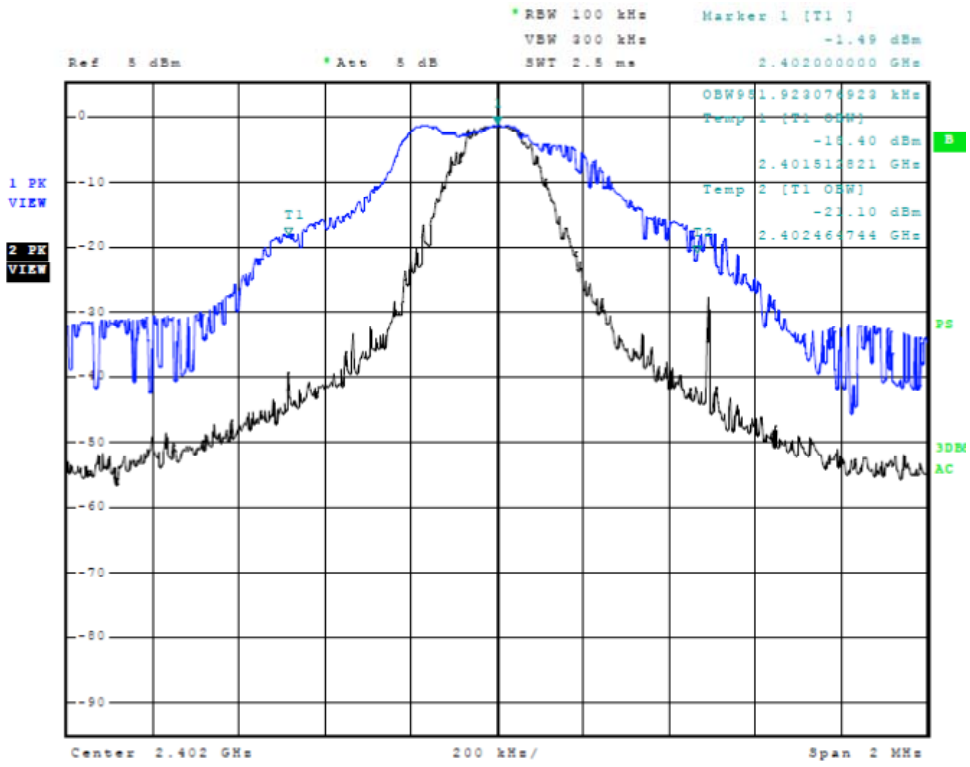


Figure Twenty-four Occupied Bandwidth (low channel)

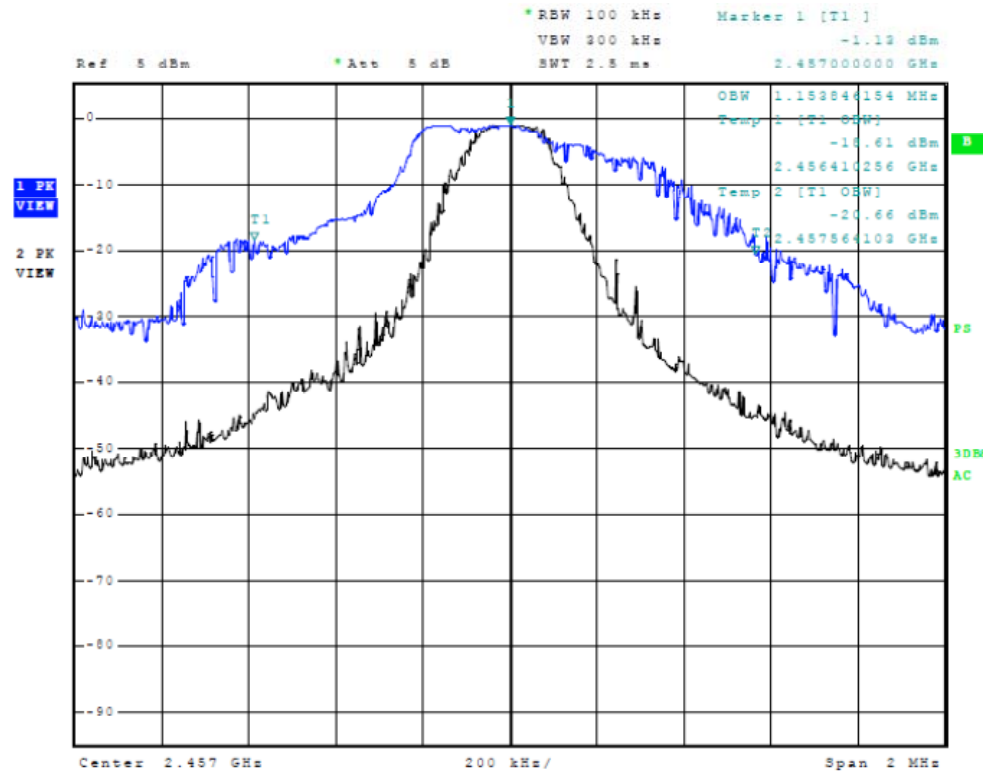


Figure Twenty-five Occupied Bandwidth (middle channel)

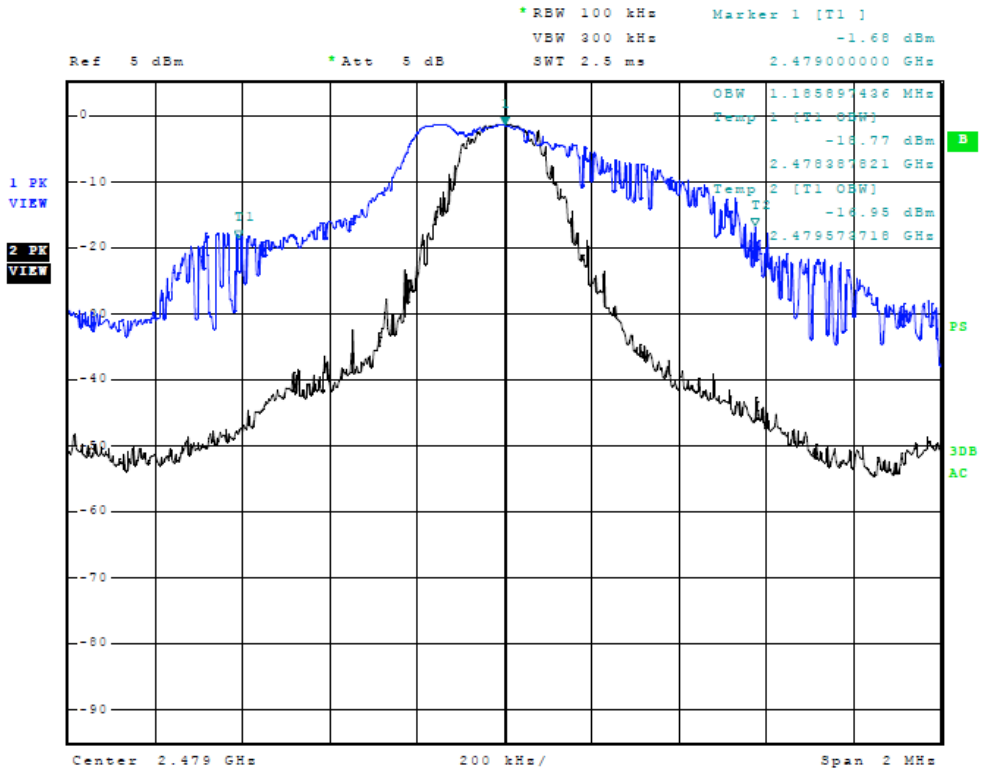


Figure Twenty-six Occupied Bandwidth (high channel)

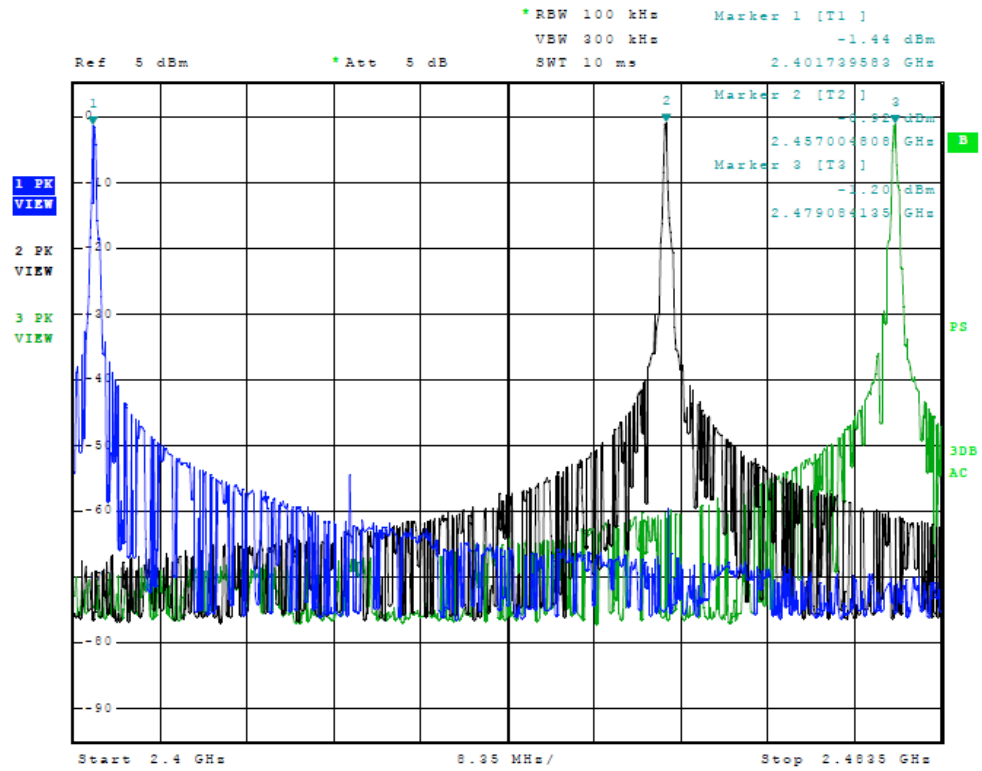


Figure Twenty-seven Operation across frequency band

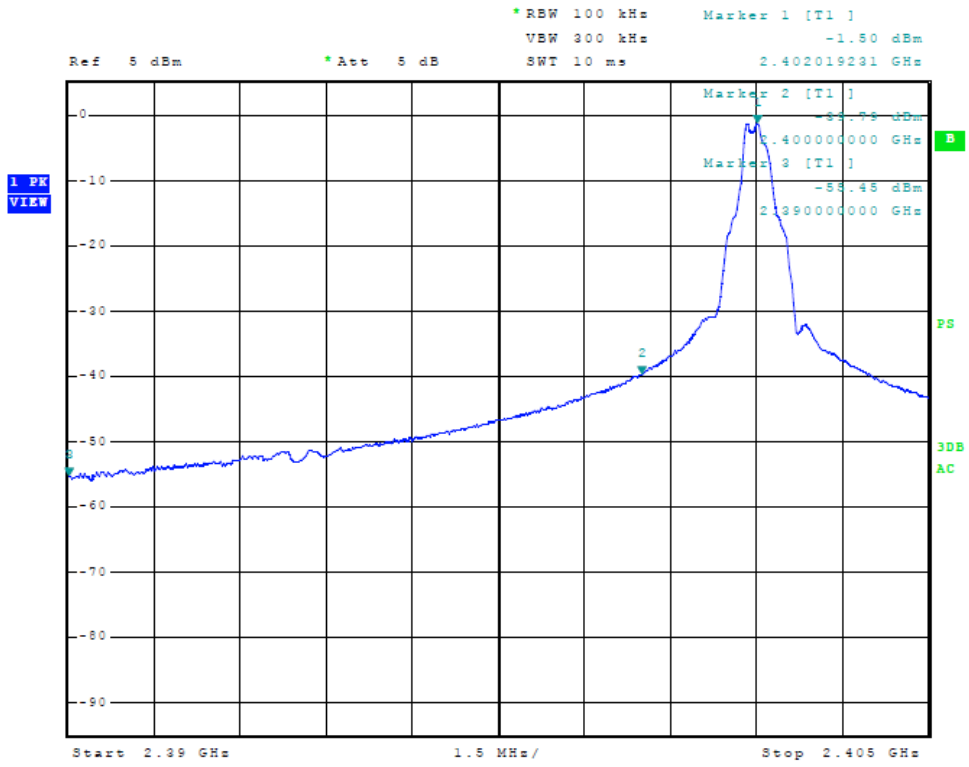


Figure Twenty-eight Low Frequency Band Edge

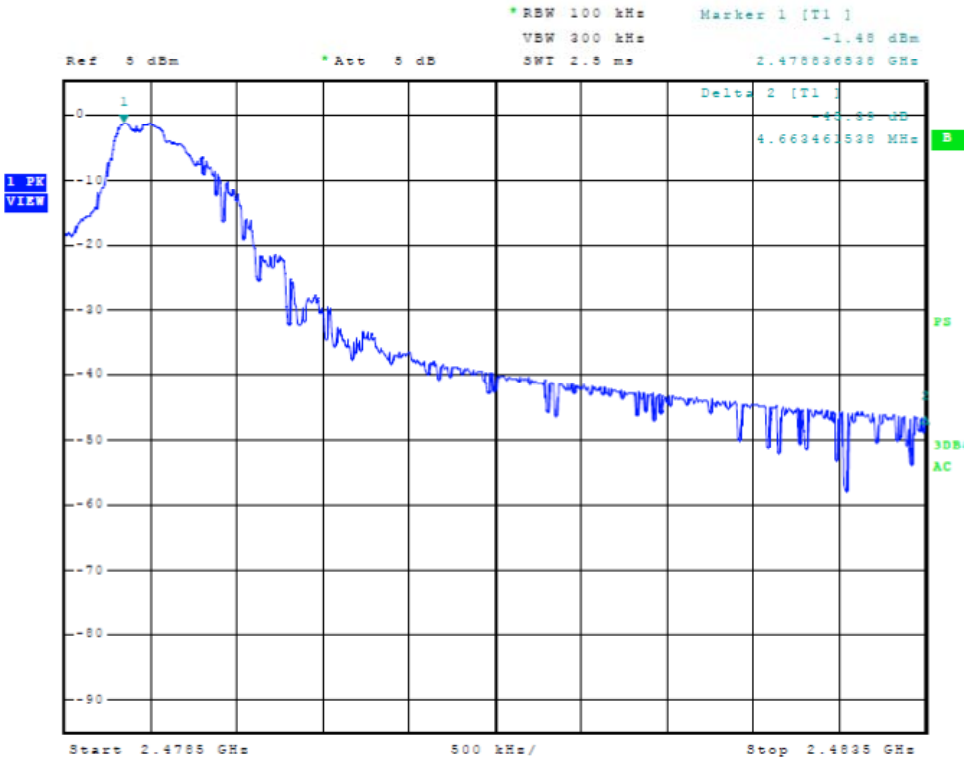


Figure Twenty-nine High Frequency Band Edge

Transmitter Radiated Emissions Data

Transmitter Antenna Port Conducted Emissions Data

Frequency MHz	Antenna Conducted Output Power dBm	Occupied Bandwidth kHz
2402.0	-1.54	951.9
2457.0	-1.11	1,153.8
2479.0	-1.28	1,185.6

Transmitter Radiated Emissions

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
2402.0	81.9	N/A	53.3	86.2	N/A	54.3	94.0
4804.0	49.6	N/A	36.9	49.9	N/A	36.8	54.0
7206.0	46.1	N/A	33.5	45.6	N/A	33.4	54.0
9608.0	50.3	N/A	37.8	50.5	N/A	37.8	54.0
12010.0	48.5	N/A	36.4	49.1	N/A	36.5	54.0
14412.0	50.1	N/A	37.5	49.7	N/A	37.5	54.0
2457.0	85.4	N/A	53.6	86.9	N/A	55.0	94.0
4914.0	47.0	N/A	34.8	47.5	N/A	34.8	54.0
7371.0	45.4	N/A	32.9	46.0	N/A	32.8	54.0
9828.0	49.9	N/A	37.2	49.7	N/A	37.5	54.0
12285.0	47.8	N/A	35.1	48.0	N/A	35.4	54.0
14742.0	51.7	N/A	39.2	52.1	N/A	39.2	54.0
2479.0	84.1	N/A	52.8	86.9	N/A	55.2	94.0
4958.0	48.8	N/A	36.3	49.0	N/A	36.3	54.0
7437.0	46.6	N/A	33.4	46.1	N/A	33.3	54.0
9916.0	50.4	N/A	37.6	50.3	N/A	37.6	54.0
12395.0	48.6	N/A	35.6	48.2	N/A	35.3	54.0
14874.0	51.1	N/A	38.5	51.0	N/A	38.5	54.0

Other emissions present had amplitudes at least 20 dB below the limit.
Peak and Quasi-Peak amplitude emissions are recorded above for frequency range of 26-1000 MHz. Peak and Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Summary of Results for Transmitter Radiated Emissions

The EUT demonstrated compliance with the radiated emissions requirements of FCC CFR 47 Part 15.249, RSS-210 and other applicable standards for Intentional Radiators. The EUT worst-case configuration average amplitude demonstrated minimum margin of -38.8 dB below the average limit. The EUT worst-case configuration demonstrated minimum radiated harmonic emission margin of -14.8 dB below the limits. No other radiated emissions were found in the restricted bands less than 20 dB below limits than those recorded in this report. Other emissions were present with amplitudes at least 20 dB below the Limits.

Annex

- Annex A Measurement Uncertainty Calculations
- Annex B Rogers Labs Test Equipment List
- Annex C Rogers Qualifications
- Annex D FCC Test Site Registration Letter
- Annex E Industry Canada Test Site Registration Letter

Annex A Measurement Uncertainty Calculations

Radiated Emissions Measurement Uncertainty Calculation

Measurement of vertically polarized radiated field strength over the frequency range 30 MHz to 1 GHz on an open area test site at 3m and 10m includes following uncertainty:

Contribution	Probability Distribution	Uncertainty (dB)
Antenna factor calibration	normal (k = 2)	±0.58
Cable loss calibration	normal (k = 2)	±0.2
Receiver specification	rectangular	±1.0
Antenna directivity	rectangular	±0.1
Antenna factor variation with height	rectangular	±2.0
Antenna factor frequency interpolation	rectangular	±0.1
Measurement distance variation	rectangular	±0.2
Site Imperfections	rectangular	±1.5

Combined standard uncertainty $u_c(y)$ is

$$U_c(y) = \pm \sqrt{\left[\frac{1.0}{2}\right]^2 + \left[\frac{0.2}{2}\right]^2 + \left[\frac{1.0^2 + 0.1^2 + 2.0^2 + 0.1^2 + 0.2^2 + 1.5^2}{3}\right]}$$

$U_c(y) = \pm 1.6$ dB

It is probable that $u_c(y) / s(q_k) > 3$, where $s(q_k)$ is estimated standard deviation from a sample of n readings unless the repeatability of the EUT is particularly poor, and a coverage factor of k = 2 will ensure that the level of confidence will be approximately 95%, therefore:

$$s(q_k) = \sqrt{\frac{1}{(n-1)} \sum_{k-1}^{n} (q_k - \bar{q})^2}$$

$U = 2\ U_c(y) = 2 \times \pm 1.6$ dB $= \pm 3.2$ dB

Notes:

1.1 Uncertainties for the antenna and cable were estimated, based on a normal probability distribution with k = 2.

1.2 The receiver uncertainty was obtained from the manufacturer's specification for which a rectangular distribution was assumed.

1.3 The antenna factor uncertainty does not take account of antenna directivity.

1.4 The antenna factor varies with height and since the height was not always the same in use as when the antenna was calibrated an additional uncertainty is added.

1.5 The uncertainty in the measurement distance is relatively small but has some effect on the received signal strength. The increase in measurement distance as the antenna height is increased is an inevitable consequence of the test method and is therefore not considered a contribution to uncertainty.

1.6 Site imperfections are difficult to quantify but may include the following contributions:
-Unwanted reflections from adjacent objects.
-Ground plane imperfections: reflection coefficient, flatness, and edge effects.
-Losses or reflections from "transparent" cabins for the EUT or site coverings.
-Earth currents in antenna cable (mainly effect Biconical antennas).

The specified limits for the difference between measured site attenuation and the theoretical value (± 4 dB) were not included in total since the measurement of site attenuation includes uncertainty contributions already allowed for in this budget, such as antenna factor.

Conducted Measurements Uncertainty Calculation

Measurement of conducted emissions over the frequency range 9 kHz to 30 MHz includes following uncertainty:

Contribution	Probability Distribution	Uncertainty (dB)
Receiver specification	rectangular	±1.5
LISN coupling specification	rectangular	±1.5
Cable and input attenuator calibration	normal (k=2)	±0.5

Combined standard uncertainty $u_c(y)$ is

$$U_c(y) = \pm \sqrt{\left[\frac{0.5}{2}\right]^2 + \frac{1.5^2 + 1.5^2}{3}}$$

$U_c(y) = \pm 1.2$ dB

As with radiated field strength uncertainty, it is probable that $u_c(y) / s(q_k) > 3$ and a coverage factor of k = 2 will suffice, therefore:

$U = 2\ U_c(y) = 2 \times \pm 1.2$ dB $= \pm 2.4$ dB

Annex B Rogers Labs Test Equipment List

The test equipment used is maintained in calibration and good operating condition. Use of this calibrated equipment ensures measurements are traceable to national standards.

List of Test Equipment	Calibration Date
Oscilloscope Scope: Tektronix 2230	2/10
Wattmeter: Bird 43 with Load Bird 8085	2/10
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/10
H/V Power Supply: Fluke Model: 408B (SN: 573)	2/10
R.F. Generator: HP 606A	2/10
R.F. Generator: HP 8614A	2/10
R.F. Generator: HP 8640B	2/10
Spectrum Analyzer: Rohde & Schwarz ESU40	5/11
Spectrum Analyzer: HP 8562A, Mixers: 11517A, 11970A, 11970K, 11970U, 11970V, 11970W HP Adapters: 11518, 11519, 11520	5/11
Spectrum Analyzer: HP 8591EM	5/11
Frequency Counter: Leader LDC825	2/10
Antenna: EMCO Biconilog Model: 3143	5/11
Antenna: EMCO Log Periodic Model: 3147	10/10
Antenna: Antenna Research Biconical Model: BCD 235	10/10
Antenna: EMCO Dipole Set 3121C	2/10
Antenna: C.D. B-101	2/10
Antenna: Solar 9229-1 & 9230-1	2/10
Antenna: EMCO 6509	2/10
Audio Oscillator: H.P. 201CD	2/10
R.F. Power Amp 65W Model: 470-A-1010	2/10
R.F. Power Amp 50W M185- 10-501	2/10
R.F. Preamp CPPA-102	2/10
LISN 50 µHy/50 ohm/0.1 µf	10/10
LISN Compliance Eng. 240/20	2/10
LISN Fischer Custom Communications FCC-LISN-50-16-2-08	2/10
Peavey Power Amp Model: IPS 801	2/10
Power Amp A.R. Model: 10W 1010M7	2/10
Power Amp EIN Model: A301	2/10
ELGAR Model: 1751	2/10
ELGAR Model: TG 704A-3D	2/10
ESD Test Set 2010i	2/10
Fast Transient Burst Generator Model: EFT/B-101	2/10
Current Probe: Singer CP-105	2/10
Current Probe: Solar 9108-1N	2/10
Field Intensity Meter: EFM-018	2/10
KEYTEK Ecat Surge Generator	2/10
Shielded Room 5 M x 3 M x 3.0 M	

Annex C Rogers Qualifications

Scot D. Rogers, Engineer

Rogers Labs, Inc.

Mr. Rogers has approximately 17 years experience in the field of electronics. Six years working in the automated controls industry and 6 years working with the design, development and testing of radio communications and electronic equipment.

Positions Held

Systems Engineer: A/C Controls Mfg. Co., Inc. 6 Years

Electrical Engineer: Rogers Consulting Labs, Inc. 5 Years

Electrical Engineer: Rogers Labs, Inc. Current

Educational Background

Bachelor of Science Degree in Electrical Engineering from Kansas State University

Bachelor of Science Degree in Business Administration Kansas State University

Several Specialized Training courses and seminars pertaining to Microprocessors and Software programming

NVLAP Lab Code 200087-0

Annex D FCC Test Site Registration Letter

FEDERAL COMMUNICATIONS COMMISSION

Laboratory Division
7435 Oakland Mills Road
Columbia, MD 21046

May 18, 2010

Registration Number: 90910

Rogers Labs, Inc.
4405 West 259th Terrace,
Louisburg, KS 66053

Attention: Scot Rogers,

Re: Measurement facility located at Louisburg
~~3 & 10 meter site~~
Date of Renewal: May 18, 2010

Dear Sir or Madam:

Your request for renewal of the registration of the subject measurement facility has been received. The information submitted has been placed in your file and the registration has been renewed. The name of your organization will remain on the list of facilities whose measurement data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Please note that the file must be updated for any changes made to the facility and the registration must be renewed at least every three years.

Measurement facilities that have indicated that they are available to the public to perform measurement services on a fee basis may be found on the FCC website www.fcc.gov under E-Filing, OET Equipment Authorization Electronic Filing, Test Firms.

Sincerely,

Phyllis Parrish
Industry Analyst

NVLAP Lab Code 200087-0

Annex E Industry Canada Test Site Registration Letter

Industry Canada Industrie Canada

May 26, 2010

OUR FILE: 46405-3041
Submission No: 140719

Rogers Labs Inc.
4405 West 259th Terrace
Louisburg, KY, 66053
USA

Attention: Mr. Scot D. Rogers

Dear Sir/Madame:

The Bureau has received your application for the renewal of a 3/10m OATS. Be advised that the information received was satisfactory to Industry Canada. The following number(s) is now associated to the site(s) for which registration / renewal was sought **(3041A-1).** Please reference the appropriate site number in the body of test reports containing measurements performed on the site. In addition, please keep for your records the following information;

- Your primary code is: **3041**

- The company number associated to the site(s) located at the above address is: **3041A**

Furthermore, to obtain or renew a unique site number, the applicant shall demonstrate that the site has been accredited to ANSI C63.4-2003 or later. A scope of accreditation indicating the accreditation by a recognized accreditation body to ANSI C63.4-2003 or later shall be accepted. Please indicate in a letter the previous assigned site number if applicable and the type of site (example: 3 metre OATS or 3 metre chamber). If the test facility is not accredited to ANSI C63.4-2003 or later, the test facility shall submit test data demonstrating full compliance with the ANSI standard. The Bureau will evaluate the filing to determine if recognition shall be granted.

The frequency for re-validation of the test site and the information that is required to be filed or retained by the testing party shall comply with the requirements established by the accrediting organization. However, in all cases, test site re-validation shall occur on an interval not to exceed two years. There is no fee or form associated with an OATS filing. OATS submissions are encouraged to be submitted electronically to the Bureau using the following URL;
http://strategis.ic.gc.ca/epic/internet/inceb-bhst.nsf/en/h_tt00052e.html.

If you have any questions, you may contact the Bureau by e-mail at certification.bureau@ic.gc.ca Please reference our file and submission number above for all correspondence.

Yours sincerely,

Dalwinder Gill

Dalwinder Gill
For: Wireless Laboratory Manager
Certification and Engineering Bureau
3701 Carling Ave., Building 94
P.O. Box 11490, Station "H"
Ottawa, Ontario K2H 8S2
Email: dalwinder.gill@ic.gc.ca
Tel. No. (613) 998-8363
Fax. No. (613) 990-4752